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The Hybrid model: Investigating bilingual language production through code-switching

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PhD

University of Edinburgh

2018

Declaration

I hereby declare that this thesis is of my own composition, that it contains no material previously submitted for the award of any other degree, and that the work reported in this thesis has been executed by myself.

Anthony Selles
Edinburgh, 11 June, 2018

Acknowledgements

I purposely left this section for last because it is the most difficult for me to write. I cannot possibly list all the names of the people who have helped me along the way, both personally and academically. I will start by thanking my supervisors Martin Pickering and Holly Branigan. They both allowed me to work independently on my projects but were always around to lift my spirits when I started to lose confidence in my work. I came out of every meeting with Martin and Holly feeling confident, feeling a hundred times better than I had before seeing them.

I would also like to thank everyone who helped me with my language materials. Mariana Vega-Mendoza helped me countless times with my Spanish experiments, from helping me with translations or just chatting about aspects of the language. Francois Forre helped me with French materials and recorded my audio stimuli for my French experiments. Judith Kahl shared my interest in German syntax and was a huge help in putting together materials for my German experiments. Felix Suessenbach was also a huge help with my German experiments, helping me with translations and aspects of German grammar. I am just happy I did not scare him away with all my questions about statistics, without his help I could not have finished my data analyses.

I attribute my enrolment in postgrad to Chris Oriet, my undergraduate supervisor at the University of Regina. Chris demonstrated a passion for cognitive psychology that I found infectious. I do miss our chats in his office, he was an inspiration to me.

A big thank you goes to everyone on the Edinburgh Universities Ice Hockey Club. I played 7 seasons with the club, 5 seasons as team captain. I have seen a lot of faces come and go, but I will always remember you. The ice hockey team was one of my solid foundations over the course of my studies and I have joked many times that it was the only thing keeping me sane.

I would like to thank my parents who have supported me this whole time from Canada. Thank you for always believing in me. Finally, a special thank you to my wife for without her by my side these last few years would have been impossible.

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Abstract

Bilingual language production is an area of psycholinguistic research that has received recent attention. Experimental evidence from bilingual word production tasks has shown that both languages share representation at the mental lexicon, meaning that concepts will lead to the activation of the target lemma from both languages. Investigations into how bilinguals organise two grammatical systems has largely come from cross-linguistic syntactic priming. Syntactic priming is a phenomenon in which speakers are likely to repeat a syntactic structure in which they have recently experienced: cross-linguistic syntactic priming is when a speaker uses a syntactic structure in one language because they have recently experienced that structure from the other language. Together, the study of the bilingual lexicon and syntactic representations have led to the development of models of bilingual language production.

A more recent experimental paradigm is the forced code-switching task in which participants are required to code-switch in some experimental trials. The forced code-switching task is the experimental method used in this thesis. This thesis aims to use this experimental task to test my proposed model of bilingual language production, the Hybrid model. The Hybrid model proposes an architecture of the bilingual lemma stratum that differs from previous models of bilingual language production. The Hybrid model assumes that lexical items from one language can be produced using the syntactic structure of the other language.

In this thesis I report seven experiments testing the proposed lemma stratum of the Hybrid model. Experiment 3.1 investigated the production of prenominal adjectives of English and postnominal adjectives of Spanish during code-switching between Spanish and English to see whether speakers would use the lexical items from one language with the word order of the other language. The results showed that speakers almost exclusively used the word order dictated by the language in which they produced the lexical items. This did not support the proposed lemma stratum of the Hybrid model.

Experiments 4.1 and 4.2 investigated gender agreement of possessive pronouns during code-switching between Spanish and English to see if the possessive pronoun from one language could be produced using the gender

agreement rules from the other language. The results showed that English-Spanish and Spanish-English bilinguals sometimes produced possessive pronouns in one language with the gender agreement rules from the other language. It was demonstrated that this effect was not due to a misunderstanding of the gender agreement rules of the participants' second language. These results support the proposed lemma stratum of the Hybrid model.

Experiments 5.1 and 5.2 investigated gender agreement of possessive determiners during code-switching between French and English to see if the possessive determiner from one language could be produced using the gender agreement rules from the other language. The results showed that English-French and French-English bilinguals sometimes produced possessive determiners in one language with the gender agreement rules from the other language. It was demonstrated that this effect was not due to a misunderstanding of the gender agreement rules of the participants' second language. These results support the proposed lemma stratum of the Hybrid model.

Experiments 6.1 and 6.2 investigated the production of determiners during code-switching between German and English. Of specific interest was whether English determiners would be produced more often than German determiners because German determiners hold case information whereas English determiners do not. In Experiment 6.1 participants were forced to code-switch before an accusative NP. The results showed that English determiners were sometimes produced within the German NPs, but German determiners were not used within the English NPs. In Experiment 6.2 participants were forced to code-switch before a dative NP. The results showed that participants almost exclusively produced the determiner in the same language as the target noun. Analysing the frequencies of the determiner used within the experimental session, the different pattern of results between Experiments 6.1 and 6.2 may be a result of a competition for selection between determiner forms.

To conclude the thesis I discuss the implications of these findings, what they mean for the Hybrid model, and directions for future research.

Lay Summary

Research into bilingual language production gives us an opportunity to examine the ways in which languages are organised in the mind. One popular technique used in language research is to test how often speakers will repeat a sentence structure they have recently heard or used. The same technique is also used with speakers who know multiple languages because sometimes different languages have similar sentence structures. Using this technique researchers have found that it is likely speakers of multiple languages only store their grammatical knowledge in one area of their mind, but grammatical rules are marked for the language in which they correspond to. The benefit of storing grammatical knowledge in one area is so the speaker does not have to store multiple instances of the same rules when the particular rule is shared between the languages.

My thesis aims to increase our knowledge of language production by using a different research technique. In my thesis I force bilingual speakers to switch languages at a specific point in a sentence in which the two languages have different grammatical rules. The purpose of this technique is to see whether the speakers can easily adapt to using the grammatical rules of the language they switched to, or if they continue to use the rules of the previous language. In my thesis I report seven experiments using this technique and my results support the view that we store grammatical knowledge in one area of the mind regardless of the language the rules belong to. However, my results show that the answer may not be as straightforward as previously thought, and in order to accommodate these findings I have proposed a new model of bilingual language production, the Hybrid model.

Chapter 1

Introduction

1.1 Background

Over the past decade, psycholinguists have become interested in the nature of bilingual language production. Early research into bilingual language production was primarily interested in the nature of lexical selection. Research into bilingual lexical selection consisted of picture naming and translation tasks and the results showed that the access of words in one language also activated conceptually related words of the other language (Colomé, 2001; Costa & Caramazza, 1999). These experiments revealed that lexical items in one language activate and compete for selection with conceptually related lexical items in the other language. This suggests that lexical items share representation for both languages in the mental lexicon. More recently, researchers have become interested in bilingual language production at the sentence level. A number of studies exploiting the grammatical choices available to bilingual speakers in both languages have found that syntactic structures also share representations.

The shared syntactic representation account has been demonstrated in studies using *cross-linguistic syntactic priming* (Bernolet, Hartsuiker, & Pickering, 2007, 2009; Hartsuiker, Pickering, & Veltkamp, 2004; Kantola & van Gompel, 2011; Loebell & Bock, 2003; Meijer & Fox Tree, 2003) and forced *code-switching* paradigms (Hatzidaki, Branigan, & Pickering, 2011; Kootstra, van Hell, & Dijkstra, 2010; Kootstra, Van Hell, & Dijkstra, 2012). *Syntactic priming* is the phenomenon in which speakers are likely to produce a recently experienced syntactic construction. A recently experienced syntactic construction primes the production of that same syntactic construction. *Cross-linguistic syntactic priming* is when a syntactic construction in one language primes the production of the same syntactic construction in another language. *Code-switching* is a phenomenon in bilingual language production in which bilingual speakers switch from one language to the other within the same utterance. Code-switching requires a reasonable knowledge of

both languages in order for the languages to be switched quickly without hesitation (Myers-Scotton & Jake, 2014; Poplack, 1980; 1981).

Together, research on sentence production has given insight to the way in which bilingual language production is sensitive to the competition for selection of lexical items and syntactic structure from both languages. Because lexical and syntactic representations are shared, bilinguals are able to switch languages quickly and efficiently without the use of too many cognitive resources. Psycholinguistic models of bilingual language production provide details into how bilinguals store lexical items and syntactic structures from both languages. These psycholinguistic models are constructed through data analysed in the laboratory rather than in naturalistic settings and have provided evidence to support a view in which lexical items and syntactic structures share representations, and are activated and compete for selection between languages. Linguistic models of code-switching are based on naturally occurring code-switched speech that is transcribed and analysed. Through the analysis of naturally occurring code-switching, researchers have identified distinct patterns in the ways in which both languages are used. Myers-Scotton & Jake (1995) and Myers-Scotton (1997) detail the most comprehensive linguistic account of code-switching and suggest that one language provides the syntactic frame of the utterance, whereas the other language is mostly limited to individual nouns and verbs. Psycholinguistic models do not attempt to explain this pattern of language use, rather they seek only to model the choices available to the bilingual speaker, and the mechanisms involved in selection and output.

The purpose of this thesis is to propose a comprehensive model of code-switching based on the experiments reported in this thesis. By combining the experimental evidence-based psycholinguistic models of lexical access and syntactic representation of bilingual language production with linguistic models of natural code-switching, I develop a model of bilingual language production that aims to explain the lexical and syntactic choices available to the bilingual speaker, and the syntactic patterns that occur during code-switching. Ultimately, the purpose of this thesis is to put forth and test the Hybrid model, an attempt at a comprehensive model that accounts for code-switching during bilingual language production.

1.2 Thesis structure

This thesis is structured as follows. Chapter 2 is the literature review section in which I discuss research into language production. In this chapter I report how syntactic priming research lead to the modelling of the monolingual lemma stratum, the way in which words are connected to the syntactic structures they can form. Next I discuss how cross-linguistic syntactic priming supports a bilingual adaptation of lemma stratum. I then give an overview of linguistic approaches to code-switching concentrating on the production model, the Matrix Language Frame model (Myers-Scotton, 1997; Myers-Scotton & Jake, 1995), and the model of morpheme distinction, the 4-M model (Myers-Scotton, 2002; Myers-Scotton & Jake, 2000b, 2016). I then attempt to explain how psycholinguistic models of bilingual language production are compatible with the Matrix Language Frame model of code-switching. Finally I propose the Hybrid model of bilingual language production. In Chapter 3 I report an experiment that tests code-switching between English and Spanish by manipulating the difference in the order of which nouns and adjectives are produced. In Chapter 4 I report two experiments that test code-switching between English and Spanish by manipulating the difference in gender agreement rules of possessive pronouns. In Chapter 5 I report two experiments that test code-switching between English and French by manipulating the different gender agreement rules of possessive determiners. In Chapter 6 I report two experiments that test code-switching between English and German that test the ways in which case-marking influences determiner selection. In Chapter 7 I conclude the thesis with a discussion on the overall results from the experiments and their consequences regarding the Hybrid model.

Chapter 2

Literature Review

2.0 Chapter summary

The current chapter is organised as follows. In section 2.1 I review psycholinguistic literature on language production from conceptualisation to formulation including the production of open- and closed-class words. I then review the literature on bilingual language production which is the main theme for this thesis. In section 2.2 I review theoretical linguistic literature on bilingual language production with an emphasis on code-switching. Dominating this section are the Matrix Language Frame (MLF) and 4-M models which together form a comprehensive account of code-switching. In section 2.3 I briefly discuss the compatibilities of both linguistic and psycholinguistic approaches towards bilingual language production and code-switching. I then propose my own model, the Hybrid model of bilingual language production which is inspired by both linguistic and psycholinguistic accounts. I detail the proposed architecture of the Hybrid model's bilingual lemma stratum, and finally I summarise the experimental chapters that aim to test this proposal.

2.1 Language production

Language production is said to be formed in three stages; (1) conceptualisation, (2) formulation, and (3) articulation (Levelt, 1989). Conceptualisation involves generating the preverbal message, formulation involves encoding the pre-verbal message into linguistic units, and articulation involves turning the linguistic units into the production of speech sounds. For the purpose of this thesis I will discuss conceptualisation and the generation of the pre-verbal message as well as formulation and how the pre-verbal message is encoded into linguistic units.

2.1.1 Conceptualisation

2.1.1.1 The preverbal message

Levelt (1989) outlines the process involved in turning a communicative intention into speech acts and finally into the preverbal message. There are two stages, *macroplanning* and *microplanning*. Macroplanning involves the selection of

information that is necessary to express the intended message. The speaker has a communicative intention, or a goal for the discourse. In order to accomplish the goal, each successive speech act must satisfy the communicative intention. In addition the speaker must know whether the expression is declarative, interrogative, or imperative. That is, whether the communicative goal is to make a statement, ask a question, or make a demand. Macroplanning turns the communicative intention into a speech act.

Microplanning involves turning the speech act into the preverbal message. There are four aspects to microplanning. The first aspect is the accessibility status of referents. Speakers will introduce and discuss persons, objects, and events; we will refer to these as referents. Throughout discourse, speakers must infer whether referents being introduced are accessible or inaccessible to the conversation partner. Inaccessible referents are referents that are unknown to the conversation partner, it is brand new information to the listener. Grammatical encoding of referents depend on their accessibility status (Levelt, 1989). However, Horton and Keysar (1996) argue for a Monitoring and Assessment model in which speakers only take common ground into consideration if the situation permits.

The speaker will generally use an indefinite determiner within a noun phrase when referring to an inaccessible referent. By marking the referent as inaccessible, the speaker is telling the listener to acknowledge the referent by adding it to their discourse model (Levelt, 1989). If the speaker believes a referent has been successfully introduced but it is no longer in focus or in the discourse model, the speaker deems the referent as accessible. The speaker will generally use a definite determiner to refer to an accessible referent. When the referent is accessible and in focus, the speaker will drop modifiers and can refer to the referent by using pronouns.

The second aspect to microplanning is topicalisation. Speakers will want to mark a referent as the topic so the listener knows what referent the message is about. One aspect of topicalising is to make the referent more salient. Human and animate objects are easier to topicalise than non-human or inanimate objects, and large moving objects are easier to topicalise than small stationary objects (Levelt, 1989). This idea is similar to that of conceptual prominence. Topics are given priority

during grammatical encoding as they are often assigned as the grammatical subject of a sentence.

Information for generating the preverbal message comes from the speaker's declarative knowledge, or knowing about the world. Declarative knowledge comes in different representations, namely spatial and propositional. Spatial representation reflects a scene in the physical world such as the route to work, or the layout of your living room. Propositional representation is the mental representation of a relationship between objects: linguistically speaking, 'when something is predicated about a referent' (Levelt, 1989; p. 71)

The preverbal message must come in a propositional format because it holds the information structure and a perspective that satisfies the speaker's goal. If the speaker wishes to communicate directions, which is information in a spatial representation, he or she will have to convert the spatial representation into a propositional format. The way in which a speaker does this is by perspective taking. In order for a speaker to communicate his or her route to work they must convert the spatial representation of the physical world into a propositional format, and the usual perspective taken would be the first person perspective of how to navigate the route. That is, the speaker takes the perspective as the person travelling the path to work. Another perspective a speaker may take to convert spatial representation into a proposition format is a bird's eye view of a map. There are different possible perspectives to take depending on the goal of the communicative intention and the cognitive style of the speaker. Ultimately the perspective taken by the speaker communicates the way in which referents and other entities relate to each other. This perspective taking is essential to propositionalise information or knowledge that is not yet in a propositional format. Finally, the last aspect of microplanning is the accessing of all relevant information necessary for grammatical encoding in the target language.

Levelt (1989) assumes the preverbal message is non-linguistic, but an important question regarding the preverbal message is the extent to which the information is specific to the language of the speaker. De Bot (2000), Levelt (1989), and Slobin (1996) propose that the preverbal message is language specific, and that the preverbal message only encodes information that is necessary for a grammatical

utterance in the target language. In Korean and Turkish, declarative messages have an evidential marker to express whether the message has any evidence to back it up or whether it is hearsay. In English we can express this information with its own phrase within the message. In other words, Korean and Turkish must encode this evidential marker within their preverbal messages whereas English does not. Other examples of language specific information that may be encoded within the preverbal message is temporal information. English among many other languages has a tense system for verbs and therefore requires the encoding of temporal information into the preverbal message. Some languages such as Malay do not have tense systems and therefore temporal information is not required to be encoded in the preverbal message. Arguing against language specificity of the preverbal message, Bierwisch and Schreuder (1992) believe that the preverbal message contains more information than what the utterance will eventually hold, and that speakers of all languages will encode this information within the preverbal message.

Antón-Méndez (2010) argues that the study of L2 errors may provide insight into the content of the preverbal message. If a bilingual speaker speaks one language that has features that are absent in the other language, patterns of language errors may emerge that are not due to a lack of knowledge of the L2 grammatical rules, but rather because they generated a preverbal message in the wrong target language.

2.1.2 Formulation

Once the preverbal message is generated, the next step in language production is formulation. Formulation is the process of transforming the conceptual representation of the preverbal message into a linguistic form.

2.1.2.1 Grammatical encoding of the preverbal message

Formulation begins with grammatical encoding. Across languages grammatical functions such as subject, direct object and indirect object are accessed the same way during formulation of the preverbal message, but they are realised differently depending on the language of the speaker. Some languages are largely *configurational* in that grammatical function is expressed by word order, or by the configuration of the surface structure (Levelt, 1989). English is an example of a configurational language because grammatical functions are assigned through word order and positions within phrase structures. Other languages are *nonconfigurational*

in that grammatical function is not expressed by the word order; the order in which words are configured with respect to surface structure has no bearing on the grammatical functions within the sentence (Levelt, 1989). Instead, grammatical function is expressed by case-marking. Case-marking is morphological in that words (nouns, determiners, and adjectives) are given affixes to their bare forms depending on their grammatical function. Subject noun phrases are usually marked by nominative case-marking, direct object noun phrases with accusative case-marking, and indirect object noun phrases with dative case-marking. In nonconfigurational languages word order is not important because the case-marking disambiguates the grammatical functions of the noun phrases. Some languages such as German encode grammatical function by a combination of word order and case-marking. Very few languages have as rigid word order as English, and in fact Old English and Early Middle English used to have case-marking morphology before largely being reduced in Middle English (Allen, 1997). Regardless of how the surface structure of the language is realised, grammatical functions are accessed the same way from the preverbal message.

The generation of the preverbal message is perhaps the area of language production that is least understood, and certainly has been the area researched the least. The difficulty in researching the generation of the preverbal message is controlling the speaker's output while measuring the speaker's intention. Recently researchers have looked into how speakers generate messages using a visual world paradigm in which participants are shown pictures or events on screen and the timing and duration of their eye fixations are measured as well as their speech (Brown-Schmidt & Tanenhaus, 2008; Gleitman, January, Nappa, & Trueswell, 2007; Konopka, 2012; Konopka & Meyer, 2014). This eye tracking methodology is an opportunity to test how speakers conceptualise an event prior to and during the production of an utterance. A consistent finding in these eye tracking experiments is that speakers tend to look at the referents in a display in the same order in which they talk about them. For transitive events in SOV languages, the first referent speakers look at tends to become the subject of the sentence and the second referent becomes the direct object. Depending on whether the referent that receives the first gaze is the

agent or the patient of the transitive event, the utterance becomes an active sentence or a passive sentence (Konopka & Brown-Schmidt, 2014).

Experimental evidence has shown that cueing attention to a specific referent on a display has an effect on assigning the subject of a sentence (Tomlin, 1997). In this study Tomlin found that by presenting an arrow to one of two referents in a display, speakers are more likely to produce active sentences when the agent of the event was cued and more likely to produce passive sentences when the patient was cued. Using a subtle perceptual cue Gleitman et al. (2007) found a similar effect of cueing and referent of first mention. Combined, these two studies show that shifts in visual attention can influence the starting point when generating a message. In addition to changes in visual attention, perceptual and conceptual properties of a referent may influence the starting positions of message encoding. Properties such as animacy and size may affect the starting point of message encoding. Other properties influencing the starting point include the referent's role in discourse, the referent's codability, and accessibility status. (Konopka & Brown-Schmidt, 2014). The role in discourse refers to whether the referent is new, has been established, or is in focus, and the referent's codability refers to how many different lexical items can be used to refer to the same referent, and accessibility status refers to frequency in which the lexical item is used.

There are two different approaches on how language is conceptualised. The two competing views are structure-driven and word-driven production. Though the research presents the structure-driven and word-driven views as competing theories, I propose these two mechanisms work together. I discuss this idea in further detail in section 2.3.2.1. In the following sections I will review both structure-driven and word-driven views and the experimental evidence supporting each view.

Structure-driven language production emphasises the relationships between referents in the event so that the first action of the speaker is to build a structure rather than select a lemma (Bock & Ferreira, 2014). In other words, the initial building of the syntactic structure is not dependent on lexical access. It is suggested that a brief sentence plan captures the relationships between referents in the given event (Kuchinsky & Bock, 2010). Evidence comes in the form of longer latencies in producing the first content word of a sentence in comparison to the following words,

suggesting that the initial delay in producing the first words comes from building a structure for the remainder of the utterance (Konopka, 2012).

Experimental paradigms have been used to manipulate referent accessibility by cueing participants to a particular referent. By using a perceptual cue, researchers can manipulate the accessibility of one referent over the other in order to influence how participants choose the starting point of their utterance. Kuchinsky and Bock (2010) conducted an eye tracking experiment in which participants described pictured events. The pictures used in the experiment depicted events with two or more referents. Kuchinsky and Bock used the same subtle perceptual cue as Gleitman et al. (2007) in order to cue the participants' visual attention to specific referents within each pictured event. The events were manipulated in their codability. For easy to code events the event was straight forward and easily understood (e.g., an ambulance crashing into a car) and were typically described by using one verb. For hard to code events, the events were difficult to interpret and served the purpose of eliciting different types of verbs from participant to participant (e.g., a group of men looking at a woman on a raised platform). Recall that in previous literature the cueing of a referent influenced the referent in being first mentioned. The results of this experiment however showed that this pattern was only true for difficult to code events. Participants were likely to look at the cued referent first regardless of the codability of the event; however, only with the hard to code events were participants more likely to use the cued referent as the subject of the sentence. For easy to code events referent cueing had no effect on who the participant chose to become the subject. Kuchinsky and Bock (2010) explain that the results suggest that for the easy to code events participants started building a structure and then chose the appropriate referents to fit within the structure they started to build. For difficult to code events, participants used the cued referent as a starting point as they coded the event.

Using a similar picture description task, van de Velde, Meyer, and Konopka (2014) manipulated the same perceptual cue as in Gleitman et al. (2007) and Kuchinsky and Bock (2010) in Experiment 1, and tested the same procedure without the perceptual cue in Experiment 2. The results of Experiment 1 showed that the perceptual cue did not influence the speaker's syntactic choice. When perceptually cued, agents were more likely to become the subject of a sentence when they were

easy to name than when they were difficult to name. Agents also showed a tendency to become the subject as default, and tended to only be produced in the object position when they were difficult to name. The results of Experiment 2 replicated those of Experiment 1. Characters who were gazed upon first were generally given the subject position, and this was modulated by the ease of naming of the agent character; if the agent was difficult to name, then the patient became the subject of the sentence.

The two previous studies manipulated referent accessibility with a perceptual cue. Konopka and Meyer (2014) explored manipulating referent accessibility with lexical priming (Experiment 1) or structural priming (Experiment 2). In an eye-tracked picture description task participants were asked to describe transitive events in which the characters were either easy or difficult to name and events were either easy or difficult to encode. Lexical primes were presented aurally and were either semantically related to the agent, the patient, or to neither character. The results showed that speakers encode the accessible characters first and build the structure to fit that character in the subject position, regardless of whether the character was the agent or the patient. The priming effects showed that the agent primes did not increase the likelihood that speakers would produce active sentences, but the patient primes decreased the likelihood that speakers would produce active sentences. This asymmetrical priming effect shows a tendency for speakers to treat agents of an event as a default subject. The observed patient prime effect was stronger in difficult to code events than for the easy to code events suggesting that easier to access characters gave speakers an easier starting point when trying to code a difficult event. Likewise, character accessibility had less of an effect in easy to code events, suggesting that for easy events speakers could use the event as the starting point and assign character roles depending on the suitability of the syntactic structure.

Eye-tracking results were consistent with findings from Gleitman et al. (2007) and Kuchinsky and Bock (2010) showing that the first fixated character had a tendency to become the subject of the sentence, and this was affected by the ease of event coding and structural assembly. The lexical priming effects on eye gaze showed that the participants first gazed upon the agent character more often following agent primes than following patient or neutral primes. Participants were

then likely to gaze away from the agent suggesting that characters in transitive events are encoded sequentially in the order in which they are gazed upon.

Experiment 2 followed the same procedure with structural priming of active, passive or intransitive prime sentences. Structural priming showed that passive primes decreased the probability that speakers would use an active structure whereas active and intransitive primes did not. The eye-tracking data showed that easy to code events did not show a reliable effect of character accessibility. However, in difficult to code events participants typically fixated towards easy agents and away from difficult agents suggesting that the participants attempted to select an easier starting point based on the characters when the event was difficult to code.

Together, these studies show a robust trend that speakers chose a starting point for message planning largely dependent on the ease of character naming and the ease of event coding. In general, speakers encode the easiest element first. If the event is easy to code then the event drives the structure of the sentence and the characters are assigned subject and object depending on their roles within the event. For difficult to code events, the agent is generally treated as the default subject resulting in an active structure. If the event is difficult to code, and the agent is more difficult to name than the patient, the speaker is more likely to assign the patient as subject resulting in the passive structure. In this case the speaker chooses the easiest element as the starting point. By choosing the easiest element as the starting point, speakers are able to plan for the rest of the message.

In contrast to structure-driven production, word-driven production assumes that words, or their lemmas, are the builders of syntactic structure during language production. A number of models of language production favour a word-driven account of language production (Dell, 1986; Hartsuiker et al., 2004; Kempen & Huijbers, 1983; Levelt, Roelofs, & Meyer, 1999; Pickering & Branigan, 1998). In these accounts, a lexical concept activates lemmas that share features with that concept. I will discuss word-driven production in further detail in the following section.

2.1.2.2 Lexical access

During formulation, the pre-verbal message is expressed as the speaker's intention which is represented by lexical concepts at the conceptual stratum. Please

note that this definition of formulation is derived from Levelt (1989). The connection between intention and lexical concepts is largely dependent on the context of the message, and thus the speaker is sensitive to pragmatic and context dependent influences (Levelt et al., 1999). For instance, whether a speaker activates the lexical concept of HEIFER or COW is dependent on the speaker's audience and knowledge of the subject matter. If the speaker were speaking to cattle ranchers he may choose to be as descriptive as possible by using the more specific *heifer* to refer to the young female bovine. However, if the speaker is simply spotting the animal to a friend, the speaker would choose the more general term *cow*. The target lexical concepts receive activation from the speaker's intentions, and when the target lexical concept is activated it sends a proportion of activation to other semantically related concepts. As an example, the lexical concept of controlling a land vehicle will activate the target verb lemma for *drive* and other semantically related concepts such as *sail*, and *fly*. *Sail* and *fly* will receive a lower level of activation because they do not fully satisfy the intended lexical concept. The lemma *drive* receives the most activation and is selected. This process will be discussed in further detail below.

It is generally agreed that lexical access is a two-step procedure (Dell & Reich, 1981; Garrett, 1975, 1988; Levelt, 1989; Rapp & Goldrick, 2000). The first step involves selecting an abstract lexical unit and its semantic and syntactic representation which is separate from phonological content. For the purpose of this thesis I will use the terminology from Levelt (1989) and refer to abstract lexical units as lemmas, however Dell (1986) refers to these as word nodes that connect to slots in the syntactic frame. The second step is mapping the abstract lexical unit onto representation of the unit's word-form. Some evidence of the two-step process of lexical access comes from speech errors, specifically slips of the tongue errors.

Garrett (1982) identified two types of slip of the tongue errors that correspond to the two steps of lexical access. First, the slip can be a semantic error in which a speaker says a semantically related word instead of the target word (e.g., *dog* instead of *cat*). This error is said to occur at the first step, during the competition of semantically related concepts (Dell, Schwartz, Martin, Saffran, & Gagnon, 1996). Second, the slip can be a phonological error in which speakers say a phonologically related word instead of the target word (e.g., *cap* instead of *cat*). This error is said to

occur at the second step (Dell, Nozari, & Oppenheim, 2014). Research into the tip-of-the-tongue state has demonstrated that speakers are able to access syntactic information of target words, such as grammatical gender, even when they are unable to access phonological information of the target words (Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997; Vigliocco, Antonini, & Garrett, 1997). The tip-of-the-tongue state suggests that speakers successfully complete the first step but cannot complete the second step.

Experiments using picture-word interference tasks have also demonstrated evidence for the two-step process. Schriefers, Meyer, and Levelt (1990) used a picture-word interference paradigm in which interference words were presented aurally. With an SOA of -150 ms, semantically related words caused semantic interference, but with an SOA of 0 and 150 ms, phonologically related words caused a facilitation effect. The semantic distractors affect picture-naming latencies earlier than the phonological distractors; this effect is consistent with two-step process of lexical access.

While evidence for the two-steps account of lexical access is overwhelming, researchers disagree as to the extent of modularity of the two-steps. Discrete models of lexical access argue that the first step must be completed before the second step can commence. Phonological representation is only activated once the semantic and syntactic information of the abstract lexical unit has been selected (Levelt, 2001; Levelt et al., 1999). In other words, the phonological information is only activated once a lemma has been selected, and is only activated for the selected lemma. Levelt et al., (1999) propose a discrete model of lexical access in language production that assumes lexical entries are represented at three levels: 1) the conceptual stratum in which semantic information is encoded, 2) the lemma stratum in which syntactic information is encoded, and 3) the form stratum in which morphological and phonological information is encoded. Under this model the two steps of lexical access occur between the lemma stratum and form stratum. Importantly, this discrete model of production does not allow cascading activation from the lemma stratum to the form stratum, and does not allow for the feedback of activation from the form stratum to the lemma stratum.

Conversely, cascade models assume all activated lemmas send cascading activation to their respective word-forms. It is suggested that semantic and syntactic information is fully activated prior to phonological activation; however, phonological activation occurs before the lemma has been selected. In other words, the cascade model suggests step two of lexical access commences before step one is completed. Peterson and Savoy (1998) provide evidence in support of the cascade view of language production. Pictures of objects with two possible names were presented in a picture naming task. The objects all had a dominant name (e.g., *couch*), and a secondary name (e.g., *sofa*). For some trials a target word was presented after the picture and the participants had to name the word. The target word was either phonologically related to the dominant name (e.g., *count*), phonologically related to the secondary name (e.g., *soda*), or was unrelated to the picture (e.g., *horse*). For picture naming trials a question mark was displayed over the picture 400 ms after the picture was displayed and participants had an 800 ms deadline to respond. This timing required participants to prepare their response at picture onset rather than wait for the presentation of the question mark. For target word naming trials a window with the target word was presented over the picture at a SOA of 50 ms, 150 ms, or 300 ms from the presentation of the picture. The naming latencies of the target word show that the picture primed the production of the target word phonologically related to the dominant name as much as the target word phonologically related to the secondary name. In order for both dominant and secondary names to be primed, multiple lexical items must receive phonological activation. This supports the cascade view that all activated lemmas send activation to the word-form level. In fact, the bulk of the evidence from research into word production favours the cascade model of lexical access (Costa, Santesteban, & Caño, 2005; Dell, 1986; Griffin & Bock, 1998; Harley, 1993; Rapp & Goldrick, 2000; Starreveld & La Heij, 1995).

2.1.2.3 *Lemma stratum*

Pickering and Branigan (1998) explored the architecture of the lemma stratum in further detail with a series of syntactic priming experiments. Syntactic priming is a phenomenon in which the exposure to a syntactic structure, either comprehension or production of the structure, facilitates the use of that structure in a subsequent utterance. The authors take a stance similar to the model proposed by

Levelt et al. (1999). Although the Levelt et al. (1999) and Pickering and Branigan (1998) approach are discrete models of lexical access, the architecture of the lemma stratum is also compatible with cascade models. Pickering and Branigan propose a model of lemma access in which three types of syntactic information are represented at the lemma stratum. Lemmas represent the base form of words, and the syntactic information held by the lemmas are represented by a network of nodes. There are three types of nodes: 1) categorical nodes, 2) featural nodes, and 3) combinatorial nodes. The categorical node contains information regarding the syntactic category of a word: whether it is a verb, a noun, or an adjective. The featural nodes contain information such as accessibility status, definiteness, number, person, and gender for nouns, and tense, mood, aspect, person, and number for verbs. Lemmas will determine their morpho-phonological form depending on featural information provided by the preverbal message. The combinatorial node contains information for the way in which a word can combine with other lexical items in order to form larger constituents.

The word-driven production model assumes this combinatorial information is what builds the syntactic structure of sentences, specifically, the combinatorial information encoded in a verb lemma's combinatorial node specifies how the verb combines with other constituents to satisfy its argument structure. For example, dative verbs require three arguments, a subject, a direct object and an indirect or oblique object. Some dative verbs like *give* accept these three arguments in the form of a DO structure and a PO structure, whereas some verbs like *donate* only accept the PO structure. Once a verb is selected, the combinatorial nodes are activated and the structure with the highest activation is chosen. Let us consider the sentence *Dave gave a gift to Sally*. In this sentence the chosen syntactic structure is a PO. With this syntactic structure, the noun lemma for *gift* is activated and selected. The lemma corresponding to the preposition *to* expressing a directional argument is activated and selected. Finally, the lemma *Sally* is activated and placed within the PP with the preposition *to*.

Pickering and Branigan (1998) conducted a series of five syntactic priming experiments in order to determine how verbs are represented within the mental lexicon. The results from these experiments showed that syntactic priming occurred,

and is unaffected in magnitude even when the verb differed in tense, aspect, and number. Syntactic priming was strongest when the same verb was used from prime sentence to target sentence; this enhanced priming is known as the lexical boost effect. Together, the findings show that combinatorial nodes are attached to the base form of the verb, and are linked to other verbs that allow the same argument structure. Furthermore, it shows that featural nodes are also attached to the base form of the verb, which then activates the appropriate tense, aspect, and number for the verb. Syntactic priming occurred when the prime sentence activated the target verb via the links between combinatorial and lexical nodes. The evidence shows that syntactic information is not stored separately for each verb, and all verbs that share the same argument structure share combinatorial nodes; see Pickering and Ferreira (2008) for a critical review of structural priming and see Mahowald, James, Futrell, and Gibson (2016) for a meta-analysis.

Cleland and Pickering (2003) found priming of complex noun phrases in the use of prenominal adjectives (e.g., *the red sheep*), and adjectives within relative clauses (e.g., *the sheep that is red*). The researchers ran a card matching game study in which participants were paired with a confederate who acted as a second participant. For the experiment the participant and confederate sat at opposite ends of a table with their views of each other obstructed. The card matching game required the participant and confederate to take turns describing cards in order for them to put the cards away in the same order. The confederate's card descriptions were scripted in order to prime the participant's descriptions with either a prenominal adjective structure or a relative clause structure. The authors found that participants tended to repeat the structure used by the confederate, and also found a lexical boost and a semantic boost effect. Priming was strongest if the noun was shared between prime and target (*sheep-sheep*), was strong when the noun was semantically related between prime and target (*sheep-goat*), and was the least strong when the noun was unrelated (*knife-sheep*). The results were explained using the lemma architecture proposed by Pickering and Branigan (1998). The lemma nodes of the prime sentence were connected with the prenominal or relative clause combinatorial node. If the confederate used the relative clause construction, this activated the participants'

relative clause combinatorial node, making it more likely that they would use that construction for their utterance.

Melinger and Dobel (2005) also found results that can be explained by the architecture of the lemma proposed by Pickering and Branigan (1998). When participants were presented with an individual verb prime that could only use one construction, participants were likely to only use that construction in their target sentence. The results suggest that the presentation of the individual verb leads to activation of the combinatorial node specific to that verb. With heightened activation of that combinatorial node, the participant is likely to repeat that structure for their utterance.

One of the major deficiencies with the word-driven account is that the word-driven account is underspecified in terms of describing the way in which closed-class items are selected for production. These models are emphasized in terms of how open-class words drive syntactic structure. If we extend the Pickering and Branigan (1998) model to apply the same form of lemma selection for content words towards the selection of closed class words we see this model is not supported by the literature on closed class production. In the following section I will review the literature regarding the production of closed-class words.

2.1.3 Production of closed-class elements

2.1.3.1 Determiner selection

During NP production, selecting the correct determiner is through a process called *indirect* election (Kempen & Huijbers, 1983; Levelt, 1989; Myers-Scotton & Jake, 2000a). Indirect election is the process in which the lemma is selected based on information from the head of the constituent (e.g., nouns in NPs) rather than information from the conceptual level or preverbal message (Garrett, 1980; Schriefers, Hantsch, & Jescheniak, 2002). Schriefers (1993) discovered a gender congruence effect and a gender interference effect during a picture-word interference task in Dutch. When the gender of the distractor word and picture name are congruent, naming latencies are faster than when the gender of the distractor word and picture name are incongruent. Schriefers (1993) explained the gender interference effect to be a result of competition between the gender features during the selection of the determiner. That is, when the picture name was masculine and

the distractor word was feminine, the activated gender features from the two nouns caused the masculine and feminine determiner forms to compete for selection which led to longer naming latencies. The congruency and interference effect in producing Dutch determiners has been replicated in other experiments (La Heij, Mak, Sander, & Willeboordse, 1998; van Berkum, 1997). Interesting to note, the gender congruency effect was absent in studies that only elicited a bare noun response (La Heij et al., 1998). That is, when picture naming did not require the production of determiners, noun distractors did not affect picture naming latencies. This is consistent with Levelt et al. (1999) and the argument that the selection of a noun's gender feature only occurs when it is necessary for agreement in the syntactic context.

An alternative interpretation of the gender interference effect comes from Schiller and Caramazza (2003) who argue that the effect is due to a competition between determiners rather than a competition of gender features. Using a similar picture-word interference paradigm, Schiller and Caramazza (2003) investigated the gender congruency effect using German determiners. The investigation involved the production of noun phrases with masculine, feminine, neuter, and plural nouns. In German, singular nouns have three different definite determiners depending on gender, the masculine determiner *der*, the neuter determiner *das*, and the feminine determiner *die*. However, plural nouns only have one determiner, *die* regardless of gender. Schiller and Caramazza (2003) replicated the gender-congruency effect for singular noun phrases, but failed to find the same effect for plural noun phrases. The authors therefore concluded that selecting the gender features of nouns is a non-competitive process. Instead, the selection of the form of the determiner is a competitive process, and the gender congruency effect is due to the competition, or lack of competition, between determiners. In the singular condition the determiners must compete for selection, but in the plural condition the form of the determiner is the same regardless of gender, and therefore there is no competition.

The introduction of the plural noun phrase to the picture-word interference paradigm by Schiller and Caramazza (2003) therefore leads to another question. What are the roles of the gender and number features for the selection of determiners in the production of noun phrases? Schriefers et al. (2002) proposed that the singular

number feature is the default when producing noun phrases, regardless of whether the noun phrase is singular or plural. According to the singular-is-default hypothesis, the singular form of the determiner is always activated, regardless of whether the noun is singular or plural. Only when the noun is plural does the plural number feature become activated. The plural feature thus activates the plural form of the determiner in addition to the default singular determiner.

In order to test for this hypothesis, Schriefers et al. (2002) conducted a series of picture naming experiments in German. The authors recorded picture naming latencies for masculine, feminine, neuter, and plural determiners and found a significant Gender by Number interaction. Specifically, the production of the plural determiner in plural noun phrases with masculine and neuter nouns had longer naming latencies than the corresponding singular masculine and neuter noun phrases. There was no such effect in the production of the plural determiner for plural feminine nouns in comparison to singular feminine nouns. Schriefers et al. (2002) suggested that for plural noun phrases, both singular and plural determiners are activated. When naming plural masculine nouns *der* and *die* are activated, when naming plural neuter nouns *das* and *die* are activated, but for naming plural feminine nouns, only *die* is activated. The longer naming latencies for masculine and neuter plural noun phrases is therefore due to the competition between determiners and not gender features.

2.1.3.1.1 Early and late selection hypothesis

Another area of research into the selection of determiners in the production of NPs investigates the point at which determiners are selected during language processing. Earlier I noted that Schriefers (1993) found a gender congruence and a gender interference effect in the production of Dutch determiners in a picture-word interference task. In an attempt to replicate the gender congruence and interference effect, Miozzo and Caramazza (1999) performed five experiments using a picture-word interference paradigm in the production of Italian determiners. Italian has masculine and feminine determiners. There are two forms of feminine determiners, “*la*” for singular nouns and “*le*” for plural nouns. There are four forms of masculine determiners. The two singular masculine determiners are “*lo*” for when the

proceeding word begins with a vowel, “s + consonant”, “gn” or an affricate, and “il” for all other instances. Miozzo and Caramazza (1999) failed to observe any gender congruency or interference effect in their five experiments. The issue of selecting the proper form of masculine determiner Italian becomes more complex when taking adjectives into account. Italian adjectives can be prenominal and postnominal. The selection of the appropriate determiner requires more than gender and phonological information from the head noun, but also phonological information from the adjective in the case of prenominal adjectives. Considering the complex nature of Italian masculine determiners and the lack of gender effects, the authors proposed a *late selection hypothesis*. The late selection hypothesis states that the target noun’s number and gender selects an allomorphic determiner, or a placeholder, until the phonological information of the entire NP is available. Miozzo and Caramazza (1999) therefore suggest that determiner selection is driven by a different process than lexical selection in that determiner selection takes place during multiple levels of processing; driven by lexical, syntactic, and phonological factors that in the case of some languages are only resolved once the entire NP has been assembled.

Additional evidence in support of the distinction between early and late selection of determiners comes from experiments with German (Schiller & Caramazza, 2003; Schriefers et al., 2002; Schriefers & Teruel, 2000), Czech (Bordag & Pechmann, 2008), Catalan and Spanish (Costa, Sebastián-Gallés, Miozzo, & Caramazza, 1999), and French NP production (Alario & Caramazza, 2002).

2.1.3.1.2 Freestanding and bound morphemes

Throughout this dissertation I will be using the term *morpheme* to describe the smallest unit of meaning for the grammar of a language. For example, in English the past-tense verb *walked* contains two morphemes, the base form *walk* and the past-tense ending *ed*. To expand beyond determiner selection and to focus on gender marked morphemes, the following will be a review of studies using picture word interference paradigms that investigated gender-marked free morphemes and gender-marked bound-morphemes. Schriefers (1993) conducted a picture-word interference paradigm with NPs consisting of gender inflected adjectives. The inflected suffix of the gender-marked adjective is a bound morpheme, and the experiment concluded

that the inflected adjective also produced a gender congruence effect, although smaller than what was demonstrated with gender-marked determiners. Additional evidence of a gender congruence effect with bound morphemes comes from Bordag and Pechmann (2008). Using Czech NPs, a gender congruence effect was found with free and bound morphemes. Conversely, Schiller and Caramazza (2003) studied German and Dutch NPs and did not find any gender congruence effect for inflected adjectives. Jescheniak, Schriefers, and Lemhöfer (2011) suggest the lack of gender congruence effect in Schiller and Caramazza (2003) may be due to only using a SOA of 0ms, whereas Schriefers (1993) tested a range of SOAs. Using Croatian free and bound morphemes, Costa, Kovacic, Fedorenko, and Caramazza (2003) again found a gender congruence effect with free morphemes, but not with bound morphemes.

Schriefers, Jescheniak, and Hantsch (2005) tested NP production in German using free-standing determiners and gender-marked inflected adjectives. As noted earlier, in German all plural determiners have the form *die* regardless of gender. That means the feminine singular determiner is convergent with the plural determiner form, whereas masculine *der* and neuter *das* are divergent from the plural determiner form. The same is true for inflected adjectives; feminine inflected adjectives are convergent with the plural inflection *-e*, whereas the masculine inflection *-er* and neuter inflection *-es* are divergent from the plural inflection. Because of this similar pattern between gender marked determiner and gender inflected adjectives, Schriefers et al. (2005) were able to test the similarities and differences of how freestanding and bound morphemes are produced. The naming latencies for determiners in plural NPs were slower for masculine and neuter nouns, and faster for feminine nouns from the singular baseline latencies. A similar pattern of naming latencies was found for plural NPs using inflected adjectives. Lemhöfer, Schriefers, and Jescheniak (2006) replicated the study conducted by Schriefers et al. (2005) with Dutch determiners and inflected adjectives. The pattern of results showed the same interaction of number and gender between determiners and inflected adjectives. The pattern of results between the two studies suggests that free and bound morphemes undergo a similar process for selection and production.

2.1.3.1.3 Competition for selection

Recent controversy in regards to determiner production is whether determiner selection is a competitive or non-competitive process. The competitive account claims that the difference in naming latencies of NPs during the picture word interference paradigm and the simple picture naming task accounts for the activation levels of the competitors during production of the target determiner. Janssen, Schiller, and Alario (2014) argue against the competitive account of determiner selection and argue that the naming latencies are due to the relative activation of the target determiner regardless of the activation from its competitors. Using a simple picture naming task in Dutch, the authors presented participants with pictures with a common gender name or a neuter gender name. The pictures were presented individually to elicit singular nouns, as well as in pairs to elicit plural nouns. The authors manipulated the format of response, requiring participants to respond with bare nouns, or with an NP including a determiner and an adjective; adjectives were elicited by changing the size of the pictures displayed. The competitive account would predict that the activation of both genders on selection of one determiner will lead to slower latencies, however the non-competitive account predicts that activation from both genders will benefit the selection of the target determiner. The results supported the non-competitive account showing a three way interaction between format, gender and number indicating that full NP production was benefited by both gender and number features. In other words, determiner selection was affected by a combination of gender and number, and this effect reduced naming latencies as predicted by the non-competitive account.

Recently, Dhooge et al. (2016) conducted a picture-word interference task in which participants underwent ERP recordings. Picture-distractor pairs were either semantically related or unrelated, and determiner congruency of the picture-distractor pairs was either congruent or incongruent. Of particular interest in the study was the measure of the go-nogo N200 which is used in tasks in which participants are required to respond to one class of stimuli but not respond to another class of stimuli. Latencies of the go-nogo N200 give an estimate for when determiner selection takes place. The results showed facilitation of semantically related distractors in the gender congruent condition suggesting that target and distractor activate the same

determiner. The semantically related distractor activated the target determiner which lead to faster naming latencies. In contrast, interference was found from semantically related distractors in the gender incongruent conditions suggesting that the target and distractor activate different determiners. The semantically related distractor activated the non-target determiner which led to longer naming latencies. These results suggest that determiner selection is a competitive process and the competitive process is cascading.

2.1.3.2 Pronoun agreement

One controversy in the area of pronoun agreement is the argument of whether pronouns are controlled by the conceptual features or grammatical features of the antecedent noun. One influential account of number agreement of pronouns and verbs is the Marking and Morphing model (Bock, Eberhard, & Cutting, 2004). For the purposes of this section I will review how the Marking and Morphing model describes the mechanisms behind pronoun agreement.

According to the Marking and Morphing model, *Marking* and *Morphing* are the two mechanisms that underlie pronoun agreement. Speakers make an evaluation of notional number at the conceptual level of the message. Using notional number, the Marking mechanism establishes abstract number of the antecedent noun which can be different from the grammatical number of the antecedent noun. There are many instances in which grammatical number is different from conceptual number. For example a collective noun such as *crowd* refers to one group of people or many individuals. Similarly, the conjunction *my brother and my best friend* can refer to one person or two people, and this can only be disambiguated by the semantics of the message. The mechanism of Marking preserves the meaning of number independently of grammatical number. Morphing calculates the number of morphologically specified number features from the lexical representation of words to determine grammatical agreement features. Grammatical number is usually used for agreement, but when the marked number is plural and there is no specified grammatical number, then the marked number controls agreement.

In a series of five experiments, Bock, Eberhard, and Cutting (2004) establish the Marking and Morphing model while investigating the roles of grammatical

number and conceptual number of collective nouns on verb and pronoun agreement and attraction. The experiments were sentence completion tasks in which participants were presented with preambles that included a subject noun and an intransitive verb with past tense inflection as to not specify the verb agreement for number. Participants were asked to complete the sentence with tag questions to elicit pronouns in their completions. Preambles consisted of a prepositional phrase within the subject NP. The following is an example of the preamble and tag question completion, “the army with the incompetent commanders retreated... didn’t they?”

The results from these experiments show that pronoun agreement is subject to attraction from grammatically plural local nouns, but not conceptually plural local nouns. Collective nouns that are grammatically singular but conceptually plural contribute to plural pronoun agreement. Noun phrases that indicated a distributive subject with singular head nouns, for example “*The picture on the postcards...*” elicited more plural pronouns than noun phrases that indicated unitary subjects with singular head nouns, for example “*The key to the cabinets...*”. Together, the results show that pronouns are sensitive to conceptual plurality of the subject noun phrase, in particular the subject noun but not to conceptual plurality of local nouns.

Though Marking and Morphing is one specific model of agreement, other researchers have examined the differences in how conceptual number and grammatical number influence agreement. One particular area of interest is whether linguistic distance from the controller noun affects agreement of grammatical or conceptual features. Personal pronouns tend to occur at a larger distance from their controller noun than verbs do, which may contribute to the difference in susceptibility to attraction between verbs and pronouns. The preference for syntactic agreement of verbs and conceptual agreement of pronouns has been found in previous research (Bock et al., 2006; Bock, Eberhard, Cutting, Meyer, & Schriefers, 2001; Bock, Nicol, & Cutting, 1999; Eberhard, Cutting, & Bock, 2005) but no one has explicitly manipulated the distance over which verb and pronoun agreement occurs. Though the difference in susceptibility to attraction may be due to a different agreement mechanism involved with verbs and pronouns, Schweppe (2013) argues that it could also be due to the difference in distance over which verbs and pronouns appear from controller noun.

Using a completion task in German, Schweppe (2013) presented participants with three sentences. The first sentence contained a collective noun. In the short distance condition, the second sentence contained gaps in which the pronoun and verb were to be completed, and the third sentence was a continuation sentence. In the long distance condition the second sentence was an intervening sentence, and the third sentence contained gaps in which the pronoun and verb were to be completed. The experiment was designed to test whether pronoun agreement would differ depending on the distance from the controller noun. The results showed that collective nouns elicited more singular pronouns in the short distance condition whereas the same collective nouns elicited more plural pronouns in the long distance condition. Schweppe describes this effect to be a function of working memory and that accessing syntactic features of the controller noun becomes more difficult as the distance increases between controller noun and pronoun. Aside from the distance effect on the use of singular or plural pronouns, there was no preference for pronouns to agree with conceptual number of the collective nouns, which runs counter to previous findings (Bock et al., 2006). However, it must be considered whether this type of experimental paradigm relates to normal language processing.

The previous discussion on pronoun agreement was focused on the number features of the antecedent noun and how these features influence the processing of pronoun agreement. Of particular interest was whether agreement followed grammatical or conceptual features of the antecedent noun. The study of gender agreement of pronouns offers the same controversy: does pronoun agreement depend on the grammatical or conceptual features of gender? Languages with a neuter grammatical gender sometimes shows a contrasts between grammatical and conceptual genders. For example, Dutch *vrouwtje* (little woman), and German *Mädchen* (girl) are conceptually feminine but grammatically neuter. There are cases in which pronouns initially agree with the grammatical gender of the antecedent noun, but as more linguistic distance is placed between the pronoun and the antecedent noun, the pronoun tends to agree with the conceptual gender. Meyer and Bock (1999) offer an example in which Dutch uses a neuter relative pronoun *dat* (that) to refer to the little old lady within the same sentence as the antecedent noun,

but then uses a feminine pronoun to refer to the same antecedent noun in the next sentence (see Example 1).

(1) *Het oude vrouwtje dat door het bos liep droeg een zware tas. Zij was...*

The little old lady that walked through the forest carried a heavy bag. She was...

(Meyer & Bock, 1999; p. 283)

Garnham, Oakhill, Ehrlich, and Carreiras (1995) found a similar trend with French and Spanish speakers in that pronouns that occurred in close proximity to the antecedent noun agreed syntactically with the antecedent noun, and as that distance became larger the pronoun then had a tendency to agree conceptually with the antecedent noun.

Using a sentence completion and continuation task in Dutch, Meyer and Bock (1999) investigated grammatical gender as the source of gender interference reported in the production of pronouns. In two experiments participants were presented aurally with a transitive sentence which was shortly followed by the visual presentation of an adjective. For example, participants heard the preamble sentence, '*kijk, daar staat de eend op pannenkoek*' (look, there is the donkey next to the bicycle) and were then shown the adjective *DOM* (STUPID). Participants were asked to reproduce the preamble sentence and start a new sentence by using the adjective in Experiment 1, or by using the adjective in a relative clause in Experiment 2. The purpose for the adjective was to prompt the use of a pronoun in place of the first noun or second noun of the initial sentence. The first noun and the second noun of the initial sentence were either the same or different gender. The results from both experiments showed that participants made more gender errors when the two nouns from the initial sentence were of different grammatical genders. The authors conclude that the results support a view that gender agreement of pronouns is dependent on the grammatical gender of the antecedent nouns at the lemma level.

Supporting the view that pronoun agreement is controlled by grammatical gender, Schmitt, Meyer, and Levelt (1999) offer an explanation of how pronouns are selected for production. Following a network model of language production (Levelt et al., 1999), grammatical gender of nouns is stored at the lemma level in the form of

feature nodes. Gender feature nodes of noun lemmas become activated, but are only selected for when it is necessary for syntactic processing, for example for the production of determiners (Roelofs, Meyer, & Levelt, 1996) or for gender agreement of pronouns (Meyer & Bock, 1999; Schmitt et al., 1999). Syntactic information for pronouns is also stored at the lemma level. The gender feature node of the antecedent noun activates the gender feature node of the pronoun lemma. If for the speaker the target noun is marked as in focus within the discourse model, then the pronoun and its syntactic features becomes accessible. In other words, at the conceptual level, concepts activate the target noun lemma (and other semantically related lemmas) and its appropriate syntactic nodes including number and grammatical gender. If the noun is marked as in focus then these grammatical features activate the syntactic nodes of the pronoun to select the proper agreement form.

Schmitt et al. (1999) devised a German lexical decision task in which participants were asked to describe a picture presented on a computer screen which was followed by another picture presented 1500 ms after voice onset. Participants were then presented aurally with a probe word or pseudoword 100 ms after the second picture, and had to decide whether it was a real word or not with a button press. Finally, participants were asked to describe the second picture. If the second picture featured the same item as the first picture, they were asked to use a pronoun. The SOA for the probe was used because it was found to indicate that phonological inhibition occurred during the production of phonologically similar words (Levelt et al., 1991). The results revealed phonological inhibition effects; naming latencies were longer when probe and target nouns were phonologically related than unrelated. Phonological inhibition was found when the participant used a noun and when the participants used a pronoun to describe the picture. Finding phonological inhibition in the pronoun condition suggests that the phonological form of the target noun is still activated during pronoun production even though the target noun is not selected. In terms of models of language production, the results support the idea that pronouns receive gender agreement from grammatical gender stored as a syntactic feature of the target noun.

For languages with gender marking, like French, Spanish, Dutch and German, evidence has shown that gender agreement of pronouns depends on the

grammatical gender of the antecedent noun (Navarrete & Costa, 2009). Models of language production generally agree that grammatical gender is a syntactic feature of nouns and that grammatical gender is stored as lexical knowledge retrieved separately from the phonological form of the noun (Caramazza & Miozzo, 1997; Levelt et al., 1999; Miozzo & Caramazza, 1997; Pickering & Branigan, 1998). Sometimes grammatical gender contrasts with conceptual gender, as demonstrated with the Dutch word *vrouwtje*, and the German word *Mädchen* in the examples above. Consistent with the claims put forth by Meyer and Bock (1999) and Schmitt et al. (1999), Navarrete and Costa (2009) also propose that the production of gender marked pronouns requires the selection of the referent noun. Testing Spanish speakers, Navarrete and Costa devised an adaptation of the picture word interference paradigm to test whether the phonological properties of an antecedent noun become activated, even though they are not selected during pronoun production.

The picture word interference paradigm Navarrete and Costa used consisted of two displays. The first display showed two pictures side by side and participants were asked to name them both. For example, a display will show an image of a table and a helmet and the participants will name them, “*la mesa y el casco*”. The second display only showed one of the previous items coloured in blue or green; participants were asked to respond by naming the object and its colour in the second display. Participants were divided into two groups, one group was asked to use a demonstrative determiner in a full noun response, *Esta mesa es verde* (this table is green), and the other group was asked to only use a demonstrative pronoun, *Esta es verde* (this is green). Distractor words were presented on the second display and were either phonologically related or unrelated, or semantically related or unrelated, and were always different gender than the target word. The two pictures presented side by side were always of different genders.

The results of the experiment showed that naming latencies for the pronoun group was slower than the naming latencies for the full noun group. The authors suggested that the slower responses may be due to the requirements of processing both the referent noun and the pronoun. For both pronoun and full noun groups, the semantically related distractors caused an interference effect leading to slower naming latencies, and the phonologically related distractors caused a facilitation

effect leading to faster naming latencies. The semantic interference effect suggests that the referent noun is selected at the lemma level, and the phonological facilitation effect suggests that the phonological form of the referent noun is also being activated, even though in the pronoun group it is ultimately not produced in the final utterance.

The three experiments cited above lead to a similar conclusion in that gender agreement of pronouns relies on the grammatical gender of the referent noun. However it is important to note that the three experiments were conducted with inanimate nouns as experimental items, using languages with grammatical gender. In these experiments the inanimate nouns do not have conceptual gender therefore only their grammatical gender features can contribute to the agreement process.

Antón-Méndez (2010) argues against a syntactic basis for gender agreement of English pronouns. One argument is that first and second person singular pronouns do not have a lexical component that would hold grammatical gender and therefore only the third person singular pronoun can be processed by grammatical gender. It is unlikely for pronouns of the same language to have different agreement mechanisms. Another argument is that there are cases in which gender is not explicitly represented lexically by the noun, but the noun can still elicit a gendered pronoun. Antón-Méndez (2010) gives the example “there was only one other person—she was wearing blue” (p. 132). In this example the antecedent noun does not have grammatical gender and therefore the gender agreement of the pronoun must be retrieved from the conceptual representation of the noun. Indeed, Corbett (1991) suggests that the purpose of pronouns is to refer to the concept of their antecedent noun rather than its syntactic properties alone. For animate entities this includes conceptual gender.

Some may argue that inanimate objects are conceptually of neuter gender. I argue however, that rather than being conceptually neuter, inanimate objects lack conceptual gender all together. If we consider the neuter gender to only be a grammatical distinction then agreement must be based on syntactic features. This is of course only applicable to languages with grammatical gender. If a language holds grammatical gender for nouns, then it should follow that these grammatical

properties are available for pronoun agreement. Because pronouns can sometimes occur at a large distance from their antecedent noun, information regarding agreement must be stored in memory. Working memory is limited and therefore the language production system must prioritise what information to keep. Research has shown that conceptual information is explicitly remembered for a longer period than syntactic information. During recall tasks, participants are generally able to recall the meaning of a sentence but cannot recall specific sentence structure or word order of the message (Sachs, 1974). It is therefore plausible to suggest that initially, pronoun agreement is dependent on the syntactic features of a message but as the distance between the antecedent noun and the pronoun becomes larger, the syntactic features become lost from memory so the speaker relies on the conceptual features to process agreement.

Ultimately, the results from the experiments reviewed above suggest that conceptual and grammatical features of the antecedent noun both play a role in pronoun agreement. Perhaps most striking are the differences in pronoun agreement with regards to gender features. The literature appears to demonstrate that for languages without gender marked nouns, pronoun agreement tends to follow conceptual gender. However, languages with gender marking on nouns show that pronoun agreement initially follows the grammatical gender of the antecedent noun, and that conceptual gender becomes increasingly more likely to influence agreement the larger the distance between the antecedent noun and the pronoun.

2.1.4 Bilingual language production

Bilingual language production is argued to occur in the same manner as monolingual language production with the three stages: conceptualisation, formulation, and articulation. The bilingual speaker must also resolve the parallel activation of both languages in order to speak in the target language. A valid model of language production must be able to explain how language is produced regardless of whether the speaker speaks one or more languages. In other words, models of monolingual language production should be able to expand and explain language production for bilinguals and multilinguals. For a model to explain bilingual language production, it must determine how the competition between languages is

resolved when it occurs, and whether lexical items and syntactic representation for each language are held in separate stores, or whether lexical items with similar concepts and similar syntactic structures are shared between languages.

2.1.4.1 Bilingual lemma stratum

Research has shown that during bilingual lexical selection, lexical items that share concepts also share representation at the lemma level (Colomé, 2001; Costa, Miozzo, & Caramazza, 1999). Investigations into the architecture of the bilingual lemma stratum began with the research question of whether similar syntactic representations across languages were held in separate stores or whether they were shared. Researchers first approached the research question by testing whether syntactic priming occurred across languages. If syntactic priming was successful across languages, then it suggests that the primed syntactic structures share representation between languages. As noted earlier, the Pickering and Branigan (1998) model assumes that syntactic priming occurs because of residual activation making the recently experienced syntactic structure more likely to be used. In order for the syntactic structure of one language to prime a similar syntactic structure in the other language, there must be a connection between the two structures in the syntactic representation of the bilingual. If syntactic representation was separate, there would be no connection between the two structures and no priming would occur.

Hartsuiker et al. (2004) proposed a bilingual adaptation of the Pickering and Branigan (1998) model which was then further elaborated by Hartsuiker and Pickering (2008). Using a confederate scripted picture description task, Hartsuiker et al. (2004) had participants listen to picture description primes in Spanish, and produce picture description responses in English. The results showed cross-linguistic syntactic priming of passive sentences; more English passive sentences were produced following Spanish passive sentences than following Spanish active and intransitive sentences. This pattern of priming suggests that similar syntactic structures across both languages share representation. Hartsuiker et al. (2004) describe the results in a bilingual adaptation of the Pickering and Branigan (1998) model. Within the lemma stratum, featural, category, and combinatorial nodes are

shared if they are similar across languages. For example, Spanish-English bilinguals will have shared passive combinatorial nodes within the lemma stratum because the passive structure in both English and Spanish are similar. In addition to the featural, category, and combinatorial nodes, Hartsuiker et al. (2004) propose a language node which tags the base form of the lemma for its respective language, and these lemmas are connected to their translation equivalents via shared combinatorial and category nodes. Because of the interconnection of nodes between languages, lexical items from both languages are activated in parallel and both languages compete for selection. Syntactic structures that are similar between languages are also activated in parallel and compete for selection. This language network explains how cross-linguistic priming of passive sentences occurs. The confederate says a passive sentence in Spanish which activates the passive combinatorial node. The participant is therefore more likely to produce a response in a passive construction because residual activation at the passive combinatorial node is connected to the English verb the speaker selects for production.

More studies investigating cross-linguistic syntactic priming support the model and architecture of the bilingual lemma stratum as proposed by Hartsuiker and Pickering (2008). Loebell and Bock (2003) found syntactic priming of dative sentences from German to English and from English to German. Using a sentence recall task, Meijer and Fox Tree (2003) found cross-linguistic syntactic priming of prepositional-object sentences in Spanish-English bilinguals. Salamoura and Williams (2006) found that single verbs could elicit cross-linguistic syntactic priming when the prime verb could only support a double object or prepositional object argument. Bernolet et al. (2007) found priming between Dutch and German relative clauses. Bernolet et al. (2009) also found priming of Dutch word-medial and word-final passive sentences with English passive sentences, and priming between Dutch and English active sentences. Kantola and van Gompel (2011) found within- and cross-linguistic priming of English and Swedish prepositional object (PO) and double object (DO) constructions. Schoonbaert, Hartsuiker, and Pickering (2007) found a translation-equivalence boost that made priming from L1 Dutch to L2 English stronger when sentences used a translation-equivalent non-cognate verb from prime to target. Cai, Pickering, Yan, and Branigan (2011) also found a translation-

equivalent boost of priming between Cantonese and Mandarin, and the translation-equivalence boost occurred in both directions. These studies on cross-linguistic syntactic priming strongly suggest shared syntactic constructions that are in part tied to lexical items that share representation between languages, and are activated and compete for selection during language production.

In addition to cross-linguistic syntactic priming, experiments manipulating intrasentential code-switching have been used to support the architecture of the bilingual lemma stratum proposed by Hartsuiker and Pickering (2008). Hatzidaki et al. (2011) tested Greek-English and English-Greek bilinguals using a sentence completion task that involved translation equivalent words that differed in number agreement. For example, the English noun *hair* and the Greek translation equivalent *μαλλί* (*mallia*) are divergent in number agreement because *hair* is a singular noun whereas *μαλλί* (*mallia*) is a plural noun. The experimental paradigm involved a critical noun that was manipulated to be either convergent or divergent in number agreement with its translation equivalent. The goal of the experiment was to investigate whether the critical nouns divergent in number agreement would interfere during sentence production. It was proposed that translation equivalent words that differ in number agreement would interfere during sentence production because the activated lemmas from the two languages would activate different featural nodes; one would activate the singular number feature node and the other would activate the plural number feature node.

Participants completed a sentence completion task in which they were presented with a sentence fragment ending with the critical noun. The sentence fragments were presented in either Greek or English, and participants were required to complete the sentence in either Greek or English. Two experiments were conducted. In the first experiment, half of the experimental items were one-language trials which only required monolingual language production. The other half of the experimental items were two-language trials that required participants to code-switch before the critical noun. The source language was defined as the language of the sentence fragment, the non-source language was the other language, and the target language was the language in which the participant was required to respond. For the one-language trials, the target language was the source language and for the two-

language trials, the target language was the non-source language. It was found that when the critical noun was divergent in number agreement participants would often produce verbs in the target language that agreed in number with the critical noun in the source language. In other words, the verb agreement in the target language was influenced by number features in the source language.

The interference effect was found even in one-language trials, suggesting that the syntax of the non-source language is activated even when it is not in use. The interference was more pronounced in trials that required code-switching, and the interference was more pronounced when the source language was the participants' L1 and when the target language was the participants' L2. The second experiment was only conducted in the participants' L2 and the results showed there was no interference from the non-source language, the participants' dominant language. This is assumed to be the case because the non-source language was suppressed throughout the experimental session, and therefore was not able to achieve a high enough activation to compete for selection. In the bilingual context, there was enough activation from the non-source language to interfere in the one-language trials because the non-source language was still required during the experimental session. These results support the theory that syntactic information of the non-source language competes with the syntactic information of the source language during sentence production.

Kootstra et al. (2010) conducted a code-switching experiment to investigate the choice of transitive word order by Dutch-English bilinguals. English only allows SVO (subject-verb-object) word order for transitive sentences, whereas Dutch allows SVO, SOV and VSO word orders. Participants were presented with a sentence fragment and were asked to complete the sentence by describing a picture using a transitive construction. Kootstra and colleagues gave the participants cues to force code-switching when describing the pictures, but only required participants to use one word in the non-source language which allowed the participants to switch back to the source language, and allowed the participants to switch at any point during the picture description. Using this method allowed the code-switching to occur as the participants wanted, and was an investigation into how bilinguals would normally code-switch. It was found that the participants had a tendency to code-switch at a

point in which the different syntactic rules of English and Dutch would not interfere with each other. Specifically, the majority of constructions used during code-switching had the SVO order. This results may seem straight forward because English only allows for the SVO order; however, even responses that were mostly Dutch were produced with the shared SVO order. The results can be explained with the Hartsuiker and Pickering (2008) model of bilingual language production. Because the SVO order is the only order allowed in English and is also allowed in Dutch, the SVO combinatorial node will receive the highest level of activation regardless of whether the target language is English or Dutch. The heightened activation of the SVO combinatorial node leads to participants using this order for most responses.

2.1.4.2 Bilingual language production and code-switching

The Hartsuiker and Pickering (2008) model is not a model of code-switching and therefore makes no specific claims regarding language use during code-switching. The model is capable of explaining the process of lexical selection and syntactic use amongst bilinguals during language production and sufficiently explains the process of bilingual lemma selection and how syntactic structures from both languages are activated in parallel and compete for selection. However, the model is underspecified in explaining the selection of closed-class items as discussed above in section 2.1.2.3.

Linguistic models of code-switching are interested in how patterns of language use depend on the nature of the participating languages. With an in-depth analysis of written code-switching corpora, Myers-Scotton (1997) and Myers-Scotton & Jake (1995; 2000) identified that both languages are not used equally during code-switching. Myers-Scotton determined that while nouns, verbs, and adjectives are equally available from the participating languages, certain words or morphemes that are dependent on syntactic structure typically come from the language that sets the syntactic frame of the utterance. In the following section I will outline the progress of linguistic approaches to code-switching, how linguistic models of code-switching have developed, and how well they describe bilingual language production and code-switching.

2.2 Linguistic models of code-switching

The important distinction between linguistic and psycholinguistic models of bilingual language production is that psycholinguistic models are interested in the cognitive mechanisms involved in the storing and accessing of lexicons and syntactic rules of both languages, whereas linguistic models are interested in the nature of both languages and the way in which the similarities and differences between languages influence the patterns of language production. Much of the early linguistic literature regarding code-switching focused on the sociolinguistic and pragmatic factors involved in code-switching (Gumperz, 1976; McClure, 1977; Veldés-Fallis, 1978). In fact, it was first thought that code-switching was a random interaction between two languages (Lance, 1975). The first attempts at forming grammatical rules to code-switched utterances came in the form of acceptability judgements of invented code-switching examples. Though these judgments were not established as strict grammatical rules, they set the ground work for what became the *constraint based approach* (Gingrás, 1974). Constraint based approaches emphasize constraints on code-switching by indicating when code-switching can and cannot occur. Despite using a methodology that was not naturalistic, the grammatical judgements revealed clear preferences in which type of switches would be ruled as acceptable and not acceptable. Later research revealed evidence suggesting that code-switching is rule governed. Poplack (1981) found that in over 1800 analysed switches between English and Spanish, there were almost no occurrences of ungrammatical utterances in either the speakers' L1 or L2. In other words, speakers used the syntactic structure for the language in which the lexical items were produced, and switches occurred at points in which the syntactic structures of both languages were compatible; this finding was also replicated in recent experimental paradigms (Kootstra et al., 2010). By analysing the patterns of code-switching, in particular what linguistic features were switched and at which point within the utterance they were switched, three general constraints to code-switching were proposed (Berk-Seligson, 1986).

2.2.1 Constraint based approach

The *equivalence constraint* proposes that language switches are constrained to points in which elements of L1 and L2 have equivalent or similar surface

structures. That is, code-switching occurs at points in which grammatical rules are shared between languages (Lipski, 1978; Pfaff, 1976), and switches do not tend to occur at points in which the grammatical rules are not shared between languages (Poplack, 1981). The *size of constituency constraint* suggests that code-switching is more likely to occur between *major constituents* than smaller constituents or individual lexemes. *Major constituents* refer to sentences, clauses, and verb phrases that are tied to the predicate (Osborne, 2008). It is also suggested that code-switching occurs most often at constituent boundaries with the exception of noun phrases, in which code-switching often occurs between the determiner and the noun (Pfaff, 1976; Poplack, 1980). Nouns account for the highest number of individual switches of all word classes (Berk-Seligson, 1986; Poplack, 1981).

The *free morpheme constraint* states that code-switching cannot occur between a *free morpheme* and a *bound morpheme* (McClure, 1981; Pfaff, 1976; Poplack, 1981). A free morpheme is a morpheme that can stand on its own, whereas a bound morpheme is defined as a morpheme that cannot occur on its own and must belong to a larger word (Kroeger, 2005). For example, the free morpheme constraint states that code-switching cannot occur between a verb stem and the subject-verb agreement suffix. In English the verb stem *walk* is a free morpheme because it can stand alone as the infinitive form of the verb and as the present tense verb form with the exception of the third person singular present. The third person singular present agreement suffix *s* is a bound morpheme because it cannot stand alone and must be suffixed to the verb stem. As an example, code-switching will not occur with the verb stem *walk* in English with the Spanish third person singular present agreement suffix *a*. The free morpheme constraint can be best summarised by stating code-switching cannot occur “at a point of morpheme binding,” (Berk-Seligson, 1986; p. 315). In other words, code-switching does not occur with the free morpheme produced in one language and the bound morpheme produced in the other language.

The three constraints proposed above emerged from the analysis of code-switching in Spanish speaking communities in the United States. Gumperz and Hernández-Chávez (1975) analysed code-switching within Chicano populations, Poplack (1980; 1981) analysed code-switching within Puerto Rican communities, and Pfaff (1976) analysed code-switching within Mexican communities. As a

consequence, the pattern of code-switching which led to the three grammatical constraints could simply be a consequence of how Spanish and English interact in language contact.

To test whether the three constraints can be generalised to other instances of language contact, Berk-Seligson (1986) tested the three constraints with data from Spanish-Hebrew bilinguals. The Spanish-Hebrew code-switching data showed that the vast majority (96%) of switches were in one direction, starting with Spanish switching into Hebrew. This is in contrast with the Spanish-English data reported by Poplack (1980) suggesting that bilinguals code-switched evenly between L1 and L2. Poplack (1980) also reported more intrasentential code-switching by more competent bilinguals, and that less competent bilinguals preferred to code-switch intersententially. Berk-Seligson (1986) found no relationship between bilingual competence and rates of intrasentential code-switching, and that regardless of bilingual competence, speakers code-switched intrasententially more often than intersententially, meaning that switching often occurs within a sentence rather than between sentences. Berk-Seligson (1986) found that code-switching occurred most often in small constituents than in major constituents; individual nouns accounted for the highest number of switches contrary to the analyses by Gumperz (1976) and Poplack (1980). This pattern of code-switching violates the size of constituent constraint that was supported by the Spanish-English code-switching data.

In addition, Berk-Seligson (1986) reported many instances in which code-switching violated L1, L2, or both L1 and L2 grammatical rules. The most frequent code-switching error reported in the Spanish-Hebrew data is the omission of determiners in a noun phrase. In the following examples Spanish is represented by the underlined text. Please note that the examples provided below for 2a, 2b, and 2c, including the pseudo-phonological notation are quoted from Berk-Seligson (1986) with my addition of the intended Spanish orthography. Example (2a) shows the missing Hebrew definite clitic marker prefix 'ha-' before 'kotel', which acts as the marker for definiteness of a noun in Hebrew similar to how a definite article would mark definiteness of a noun in Spanish. The second most frequent error was omitting the copula. Example (2b) shows the missing copula 'is' connecting the subject 'wife' and complement 'nurse'. The third most frequent error was omitting prepositions and

prepositional phrases. Example (2c) shows the missing preposition ‘in’ before the noun ‘Hebrew’.

(2a) I ánde ez kotél hamaraví, haír atiká, ái nasyó mi mádre.

Y donde ez kotél hamaraví, haír atiká, alli nació mi madre.

And where (the) Western Wall is, the Old City, there my mother was born.

(2b) La muzér axót.

La mujer axót.

His wife (is) (a) nurse.

(2c) Unas kwántas palaávraz saviya ivrít.

Unas cuántas palabras saviya ivrít.

A few words he knew (in) Hebrew.

(Berk-Seligson, 1986)

These three types of error demonstrate that the Spanish-Hebrew bilinguals were code-switching at points in which the syntax of both languages are not equivalent, thus violating the equivalence constraint. It was found however that the Spanish-Hebrew data supported the free morpheme constraint. Further analysis suggested the ungrammatical utterances may have been a result of speakers conforming to the free morpheme constraint. In Hebrew, determiners are affixed to the noun and are bound morphemes, whereas determiners in Spanish are free morphemes. Similarly, prepositions in Hebrew are also bound morphemes affixed to the noun whereas in Spanish they are free morphemes. As a consequence, switches that omitted the determiner or preposition in either language violated the equivalence constraint, but were consistent with the free morpheme constraint (Berk-Seligson, 1986).

In sum, there is plenty of evidence in support of the three major constraints put forth by proponents of the constraint based approach to code-switching (Lipski, 1978; Pfaff, 1976; Poplack, 1980, 1981). However, all of the evidence in favour of the three major constraints is derived from studies involving populations of Spanish-English bilinguals. As demonstrated by Berk-Seligson (1986), data that runs counter

to the constraint based approach can be found by analysing code-switching from other language pairs. It was demonstrated that Spanish-Hebrew bilinguals violated the equivalence constraint and size of constituent constraint during code-switching. The constraint based approach lacks external validity and must be able to account for more than code-switching between English and Spanish. As a consequence, Myers-Scotton (1993; 1997) proposed the Matrix Language Frame (MLF) model which attempts to account for the patterns of code-switching found from many languages sets. In the next section I will discuss the MLF model in greater detail.

2.2.2 Matrix Language Frame model

The MLF model (Myers-Scotton, 1993; 1997) is perhaps the most comprehensive model of code-switching. Myers-Scotton (1993) identified an asymmetrical pattern of language use when speakers code-switch; one language is more heavily used than the other. The MLF model is a production model of code-switching that attempts to explain the asymmetrical pattern. In contrast to constraint based approaches that emphasise how phrase structure between languages interacts in the formation of switching constraints, the MLF model stresses the importance of cognition in language production, and the nature of how the language production system represents items within the mental lexicon. Specifically, the MLF model proposes that different classes of lexical items are accessed differently during language production. Though the MLF model still places constraints on code-switching, these constraints derive from the cognitive nature of language production.

Early in the development of the MLF model, Myers-Scotton (1993; 1997) proposed that the asymmetry of language use was due to the difference in the way in which open and closed class words were retrieved during lexical access. She claimed that open class items were available for access during lexical retrieval at the level of the mental lexicon, whereas closed class items only became available for access as larger constituents were formed. Further analysis of the open and closed class distinction showed that the distinction between early and late accessing lexical items is not so straight forward. This division between early and late accessed lexical items led to the development of the 4-M model (Myers-Scotton, 2002; Myers-Scotton & Jake, 2000b). The 4-M model receives its name from the distinction it makes

between four different types of morphemes that occupy different roles during language production. The different morpheme types and their roles will be discussed further in the following section. While both the 4-M model and MLF model are often discussed together, the 4-M model is model of morpheme distinctions whereas the MLF model is a production model. The MLF model aims to account for the observed asymmetry of the distribution of morpheme types and language in which certain morphemes are produced during code-switching.

2.2.3 4-M model: Four morpheme distinction

A valid model of language production must be capable of describing language output for monolingual and multilingual speakers. The 4-M model attempts to explain how and why speakers use both languages differently during code-switching, and also accounts for monolingual production. The 4-M model proposes a clear distinction to which items are accessed early or late during language production. Specifically, the 4-M model distinguishes the differences between four types of morphemes and how they perform different roles during language production and code-switching (Myers-Scotton & Jake, 2000a). Before detailing the way in which the 4-M model accounts for language production, it is important to understand the details of the four different types of morphemes and the roles they play during language production.

The four types of morphemes are 1) content morphemes, 2) early system morphemes, 3) bridge system morphemes, and 4) outsider system morphemes. Content morphemes are conceptually activated as lexical concepts at the conceptual level and are accessed during lexical retrieval directly from the mental lexicon. Content morphemes are selected as *maximal projections* (Myers-Scotton, 2002). The *maximal projection* refers to the extent to which a linguistic feature projects to a higher level within a syntax tree. For example, a noun can only project as high as the level of the noun phrase, and a verb can only project as high as the verb phrase. In other words, content morphemes become the heads of their constituents; nouns become the heads of noun phrases and verbs become the heads of verb phrases. The 4-M model uses a lexicalised grammar system similar to Hartsuiker and Pickering

(2008); lemmas of content morphemes hold semantic, syntactic, and morphological information of the word.

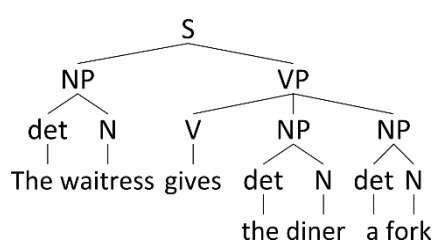
Early system morphemes, such as determiners and the plural *-s* suffix, are produced within the same maximal projection as their content morpheme heads, and depend on the content morpheme for their form (Myers-Scotton, 2002). Like content morphemes, early system morphemes are also accessed at the level of mental lexicon, however they are indirectly elected by their content morpheme head. Information required from the head noun to receive the form of the determiner depends on the rules of the specific language. English determiners rely on their head noun for information regarding number and definiteness. Spanish determiners rely on their head noun for information regarding gender, number, and definiteness. For example, in Spanish, if the head noun is singular, feminine, and definite, the form becomes *la*, and if the head noun is plural, masculine, and indefinite the form becomes *unos*.

The late system morphemes are divided into two types: bridge system morphemes and outsider system morphemes. They are considered late system morphemes because they are selected at a later stage in production than content morphemes and early system morphemes. Bridge system morphemes receive information about their form within their own maximal projection, and are used to connect content morphemes with other content morphemes in order to form larger constituents. Examples of bridge content morphemes are the possessive marker *of*, and the possessive *'s* (Myers-Scotton, 2002). Outsider system morphemes depend on information outside of their maximal projection for their form. Information outside of the maximal projection requires further constituents to be formed before it becomes available (Myers-Scotton, 2002). For example, German determiners are rich in information, they require number, gender, and definiteness information from their head noun, and are also marked for case. In order for German determiners to receive their case-marking information (aside from the nominative case), they require information from the verb or preposition that assigns case. For the accusative and the dative case this information is outside of their head constituents. Examples of outsider system morphemes are verb agreement affixes, and case-marking clitics and affixes.

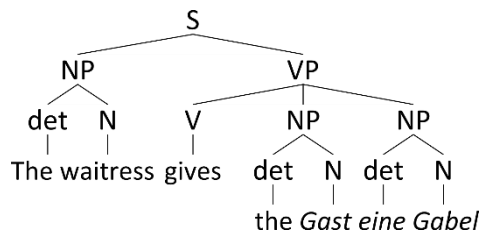
According to the 4-M model, both bridge and outsider system morphemes are late system morphemes. They are designated as late system morphemes because they are accessed at a later stage in language production, after content and early system morphemes have already been selected (Myers-Scotton, 2002, 2006, Myers-Scotton & Jake, 2000a, 2000b). Late system morphemes are required for building larger syntactic units because they map conceptual structure from content morphemes and early system morphemes onto surface structure.

2.2.3.1. *Matrix Language and Embedded Language*

Myers-Scotton uses the terms Matrix Language (ML) and Embedded Language (EL) to describe the asymmetrical use of both languages during code-switching. According to the MLF model, during code-switching the two languages in use are not used equally; only one language may provide the grammatical frame for the code-switched utterance. The language that provides the grammatical frame is referred to as the ML. The ML contributes the syntactic frame of the utterance as well as the content morphemes and functional morphemes that encode structural relations between other content morphemes. The other language in use during code-switching is the EL. The EL is limited by the processing system in that it can only be used to access content morphemes (i.e., the stems of nouns, verbs, and adjectives) and functional morphemes that are indirectly selected by content morpheme heads (determiners). In the examples below, text in regular typeface indicates the ML, and text in italics indicates the EL.

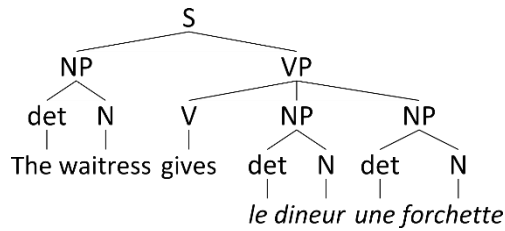


(7a) The waitress gives the diner a fork.



(7b) The waitress gives the *Gast eine Gabel*.

The waitress gives the diner a fork.



(7c) *The waitress gives *le dineur une fourchette*.

*The waitress gives the diner a fork.

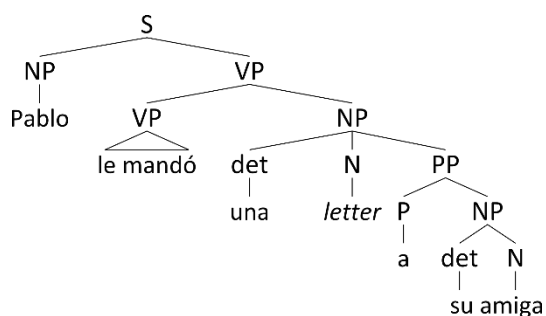
Example (7a) is a monolingual sentence with a double object construction. In this sentence, the verb *gives* assigns two noun phrases, the direct object and the indirect object. Example (7b) is the same sentence code-switched into German. The verb *gives* assigns the two noun phrases which are produced in German with the exception of the definite determiner of the direct object. According to the MLF model, this pattern of code-switching is possible because the DO construction assigned by the verb *gives* also occurs in German. The German DO construction is compatible with that of the English DO construction and therefore English and German content morphemes and determiners are accessible and available to be selected for code-switching. Conversely, the MLF model defines this rule as requiring structures between languages to be sufficiently congruent. As the EL, the German content morphemes *Gast* and *Gabel* (diner and fork) and the indefinite article *eine* (a) fit into the English grammatical frame because the German morphemes are congruent and take the same grammatical arguments as the English counterparts. However, let us consider this example using English and French (7c). French does not allow the DO construction and therefore this would not be a pattern of code-switching the MLF model would predict.

This explanation is also consistent with the Hartsuiker and Pickering (2008) model of bilingual language production. The DO construction is used in both English and German, and therefore both constructions share combinatorial nodes at the level of the lemma stratum. The shared DO combinatorial nodes then allow for the two NPs to be produced in either language. This shared representation of DO construction between German and English has also been demonstrated by cross-linguistic syntactic priming (Loebell & Bock, 2003).

2.2.3.2 *Types of code-switching constituents*

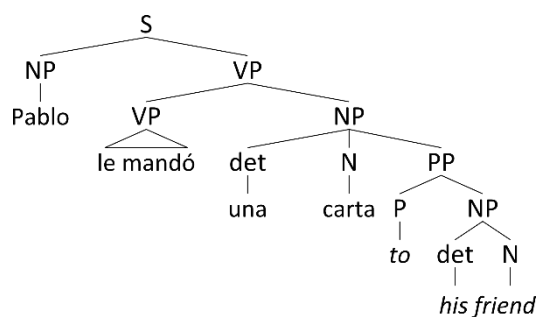
According to the MLF model there are three types of code-switched constituents; 1) mixed constituents, 2) ML Islands, and 3) EL Islands. A mixed constituent is when both ML and EL morphemes occur in the same constituent. The ML sets the grammatical frame and EL provides content and early system morphemes within the ML grammatical frame. For the following examples, Spanish is the ML and English is the EL. Example (8a) has the English noun *letter* produced in place of the Spanish noun *carta* (letter). This is an example of a mixed constituent; only a single EL noun is used within the ML grammatical frame. ML Islands are constituents with morphemes only from the ML, as shown by the Spanish nominal NP, the Spanish VP and the Spanish PP in example (8a). In other words, ML Islands are constituents that are not code-switched that are produced in the ML of the utterance. EL Islands are full constituents consisting of only EL morphemes and follow a syntactic structure that is shared between the ML and the EL. That is, the constituent formed by the EL Island must fit into ML grammatical frame. Example (8b) shows an EL Island produced within the ML grammatical frame, namely the PP. The English PP follows some of the same structure rules as the Spanish PP, and because this particular construction is permissible in both English and Spanish, this example is a possible code-switched utterance. Example (8c) shows an even larger EL Island, an NP with an embedded PP. The English NP follows some of the same phrase structure rules as Spanish, and because this construction is permissible in both languages, this is a possible code-switched utterance.. Example (8d) shows an EL Island with an English DO construction following the Spanish verb *mandar* (to send). Because this type of DO construction is not permissible in Spanish and cannot

be assigned by the verb *mandar*, this example is not a code-switched utterance that would be predicted by the MLF model.



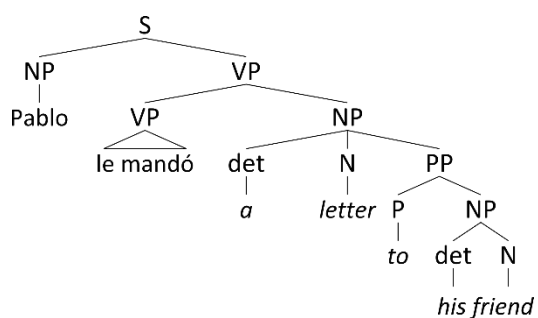
(8a) Pablo le mandó una *letter* a su amiga.

Pablo sent a letter to his friend.



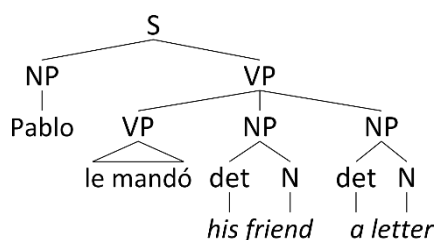
(8b) Pablo le mandó una carta *to his friend*.

Pablo sent a letter to his friend.



(8c) Pablo le mandó *a letter to his friend*.

Pablo sent a letter to his friend.



(8d)* Pablo le mandó *his friend a letter*.

*Pablo sent his friend a letter.

2.2.4 Matrix Language Frame model, 4-M model and language production

Myers-Scotton (1993; 1997) proposed a model of language production similar to the word-driven account proposed by Levelt (1989). Indeed, both the Levelt (1989) account and the MLF model are influenced by Garrett's analysis of speech errors. As noted earlier, a word-driven account assumes that lemmas hold lexical information along with semantic, syntactic and morphological information. The production model follows four abstract levels; (1) the conceptual level, (2) the mental lexicon level, (3) the formulator level, and (4) the surface level (Myers-Scotton, 2002; Myers-Scotton & Jake, 2000b). Please note that the MLF refers to formulation as the equivalent of morphological encoding and is therefore not the same as formulation in (Levelt, 1989). A diagram of the language production model of the MLF model is shown in Figure 1.

The conceptual level is pre-linguistic in nature and holds the speaker's intentions. The preverbal message is determined at the conceptualiser; the ML is set at this level. Production of the intended message involves activating lexical concepts. Activation is also spread within the conceptual network to semantically related concepts. In situations in which there is more than one way to refer to an object, pragmatic and context dependent information is used to spread activation to lemmas at the level of the mental lexicon (Levelt et al., 1999). Myers-Scotton (2002) refers to this pragmatic and context dependent information as semantic and pragmatic feature bundles which feed down from the conceptual level to the level of the mental lexicon to activate target lemmas. The semantic and pragmatic feature bundles help heighten activation of lemmas that are better suited to convey the speaker's intentions as well as taking into consideration the subject matter, and the interlocutor's knowledge of

the subject matter. For instance, an expert in a field will use different terminology when discussing his subject with other experts in the same field than when speaking to someone with only a basic knowledge of the subject. Similarly, semantic and pragmatic feature bundles can heighten activation for lemmas in the EL if the message is best conveyed by code-switching. If the speaker's intention is best expressed with morphemes in the EL, the EL counterparts of ML lemmas receive heightened activation via the semantic and pragmatic feature bundles. Lemmas at the level of the mental lexicon hold semantic and grammatical information for the morpheme. EL morphemes that receive heightened activation from the semantic and pragmatic feature bundles can be selected if their features are congruent with those of the ML counterpart, allowing the morpheme to integrate with the ML frame.

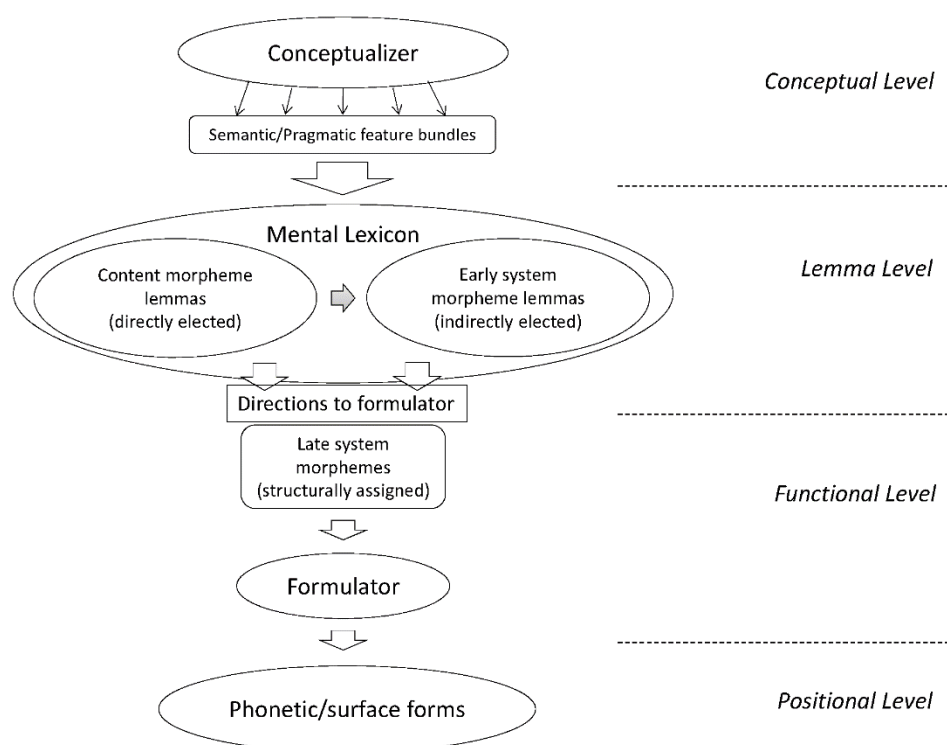


Figure 1. The MLF language production model from Namba (2002) adapted from (Myers-Scotton & Jake, 2001).

Once the content morphemes and the early system morphemes are selected at the level of the mental lexicon, they send directions to the formulator in order to form larger constituents. At the formulator, content morphemes and early system morphemes are fitted into slots of the grammatical frame and late system morphemes

are then placed to build larger syntactic structures. The formulator forms larger constituents using late system morphemes to combine with content morphemes and early system morphemes.

2.3 Hybrid model of bilingual language production

2.3.1 Introduction

In this section I will propose a Hybrid model of bilingual language production. Please note that I use the term model here as a verbal model similar to the Hartsuiker and Pickering (2008) model rather than a computational mode. First I will discuss the similarities between the Hartsuiker and Pickering (2008) model, and the MLF model (Myers-Scotton, 1997, 2002, Myers-Scotton & Jake, 1995, 2000a), and how they apply to the current model. Experimental evidence has supported the model of the bilingual lemma stratum put forth by Hartsuiker and Pickering (2008) whereas the MLF model is supported by code-switching corpora. Although both proposed models are supported by differing methods, it does not necessarily suggest that both models are incompatible. In fact, both models assume syntax is word-driven and are influenced by the model of lexical representation proposed by Kempen and Hoenkamp (1987), developed by Levelt (1989) and further elaborated by Levelt, Roelofs, and Meyer (1999). Therefore, it is reasonable to assume that both accounts should be compatible.

The language production model proposed by the MLF model has four abstract levels whereas Hartsuiker and Pickering (2008) has three. The four levels of the MLF model are the conceptual level, the mental lexicon level, the formulator level, and the surface level. Recall that the MLF model uses the formulator to refer to morphological encoding. These levels are comparable to the three levels of Hartsuiker and Pickering (2008), the conceptual stratum, the lemma stratum, and the word-form stratum. The biggest difference between these two models is the use of terminology and the way in which the levels they specify are divided.

Both models contain a conceptual level which represents the speaker's intention in terms of lexical concepts. Earlier in the section I discussed in detail the way in which a preverbal message is generated. For both models the conceptual level is the output of the preverbal message. The level of the mental lexicon of the MLF model and the lemma level of Hartsuiker and Pickering (2008) are associated with

the same process of lexical selection. At this level, lemmas are activated by the argument structure of the preverbal message, and the activation of lemmas leads to lexical selection. As discussed earlier, for word-driven accounts it is the syntactic information of the lemma that drives the generation of surface structure of a sentence.

Myers-Scotton (2002) describes an additional level during language production that remains unspecified by the Hartsuiker and Pickering (2008). In the 4-M model, content and early system morphemes are fit into slots within the grammatical frame of the ML. At a later stage in production late system morphemes are then selected and used to form larger constituents. This later stage occurs after lemma selection as the formulator receives directions for morphological encoding. Though the Hartsuiker and Pickering (2008) does not make a strict prediction in regards to early and late morpheme selection, it is sensible to suggest that late system morphemes, as specified by the 4-M model, are also accessed during morphological encoding after initial lemma selection. For both models, morphological and phonological information is encoded at the final level of language production, after the semantic and syntactic information has been encoded. However, the Hartsuiker and Pickering (2008) model makes no distinction between content, early, or late morpheme types.

2.3.2 Hybrid model

I now specify the Hybrid model of bilingual language production. The following section is structured as follows. First I will discuss conceptualisation of the message. This involves the encoding of message elements and the activation of target lexical concepts. Second I will discuss lexical selection and the architecture of the lemma stratum. This section concentrates on the selection of content morpheme lemmas, specifically nouns and verbs. Third, I discuss the selection and production of closed-class words. This section details how the Hybrid model deals with determiner selection and pronoun production, specifically how these closed-class elements receive their agreement information. Finally I discuss the early and late system morpheme distinction, how the model treats the different stages of production, and what it means for code-switching.

The Hybrid model follows the same basic architecture put forth by the MLF model and the Hartsuiker and Pickering (2008) model. Like the Hartsuiker and Pickering (2008) model of language production, the Hybrid model has three levels: the conceptual level, the lemma level and the word-form level. The conceptual level is the output of the preverbal message in the form of lexical concepts (Levelt et al., 1999). The Hybrid model however is not a strict word-driven account of language production. Following recent research into structure-driven mechanisms, the Hybrid model is influenced by both structure- and word-driven mechanisms. In the next section I discuss how both types of mechanism are involved in the activation of lexical concepts during conceptualisation.

2.3.2.1 Conceptualisation

Structure-driven accounts of language production have robust findings suggesting that the easiest element of a message is encoded first (Brown-Schmidt & Konopka, 2015; Konopka & Brown-Schmidt, 2014; Konopka & Meyer, 2014; Kuchinsky & Bock, 2010; van de Velde et al., 2014). The authors refer to ease of encoding the event or character as to how many different words are used to describe the event or character. If the easiest element is coding of the event, then speakers develop a sentence structure that best suits the event. If the easiest element to encode is the agent character of a transitive event, then that character becomes the subject of the sentence. If the easiest element to encode is the patient character, then it becomes more likely that the patient character becomes the subject of the sentence. The Hybrid model suggests that language production follows both structure- and word-driven accounts. When the easiest element for a speaker to encode is the event, then production follows a structure-driven process. When the easiest element for a speaker to encode is a character, then production follows a word-driven process. The first encoded element determines the way in which the remaining message is processed. The structure- and word-driven mechanisms drive the activation of lexical concepts after the first concept has been encoded. In other words, the easiest element is encoded first, then the activation of lexical concepts is determined by either structure- or word-driven processes. Once a lexical concept is activated, the activated lexical concept sends activation down to the target lemma at the lemma level and send activation to semantically related lemmas but to a lesser degree. In the next

section I discuss the way in which activated lexical concepts leads to lexical selection.

2.3.2.2 Lexical selection

Let us consider the case in which the lexical concept representing the event gist is activated prior to the encoding of the characters within the event. The lexical concept of the event gist represents the predicate of the sentence, and activates the target verb lemma at the lemma level. Recall that semantically related verbs are also activated but to a lesser degree, and all activated lemmas compete for selection (Levelt et al., 1999). Once a lemma is activated its syntactic properties become available. Like in the Hartsuiker and Pickering (2008) model, this information is stored in the form of categorical, featural and combinatorial nodes. The argument structure of the selected verb lemma drives the structure of the sentence. In other words, the verb sets the structural frame of the utterance. This interpretation is consistent with the findings supporting the structure-driven account (Konopka & Meyer, 2014; Kuchinsky & Bock, 2010; van de Velde et al., 2014).

The information regarding the verb's argument structure is stored at the lemma level in the form of combinatorial nodes (Pickering & Branigan, 1998). For transitive events, the verb requires a subject NP and an object NP; this information will be stored as combinatorial nodes attached to the verb lemma specifying a subject NP and object NP. For dative events, the verb requires a subject NP, an object NP and an indirect object NP or oblique object NP; this information will be stored in combinatorial nodes attached to the verb lemma specifying the requirements of a subject NP, and DO structure and/or a PO structure depending on whether the particular dative verb allows one or both DO and PO structures. Once the target lemma is selected, the combinatorial nodes then recruit the lexical concepts required to complete the production of the sentence. Because the subject noun has not yet been selected, the combinatorial nodes recruit the appropriate character to become the subject of the sentence. For the active construction of transitive events, the agent will be chosen to become the subject. For the passive construction the patient will become the subject. Once the subject noun lemma becomes activated its syntactic properties are available. The remaining lexical concepts will be selected in turn to fit within the structure established by the selected verb.

Now let us consider the case in which the lexical concept representing one of the characters within the event is activated prior to the encoding of the event gist. It is assumed that the lexical concept of the first encoded character takes the subject position within the sentence. The lexical concept activates the target lemma and the semantically related lemmas to a lesser degree. Once activated, the syntactic properties of the lemma become available in the form of categorical, featural and combinatorial nodes. As a noun in the subject position, the combinatorial node then recruits a predicate of the sentence which leads to the activation of the lexical concept underlying the event gist. The lexical concept of the event gist is then activated and leads to activation of the target verb lemma and semantically related lemmas. Once activated, the syntactic properties of the verb lemma become activated. The argument structure of the verb then drives the remainder of sentence production; the combinatorial nodes recruit the missing arguments to be activated at the conceptual level.

2.3.2.3 *Lemma stratum*

The architecture of the lemma stratum of the Hybrid model is based off Hartsuiker and Pickering (2008) model. As noted earlier, at the lemma level, the syntactic properties of the lemma are connected to categorical, featural, combinatorial, and language nodes. These nodes act in a similar manner as they do in the Hartsuiker and Pickering (2008) model. In addition, I speculate that featural nodes not only represent grammatical features of the lemma, but are also linked to conceptual features. Recall in the review on pronoun production that some nouns have different conceptual features than their grammatical features (e.g., *das Mädchen* is grammatically neuter but conceptually feminine; *herd* is grammatically singular but conceptually plural). The Hybrid model expresses this by having conceptual features at the conceptual level link with featural nodes at the lemma level. As in the Hartsuiker and Pickering (2008) model, grammatical features are also represented by featural nodes at the lemma level.

In contrast to the Hartsuiker and Pickering (2008) model, the Hybrid model is a cascaded model of language production. That is, all activated lemmas at the lemma level in turn send activation down to their corresponding word-forms at the word-form level. Competition for selection occurs at the word-form level. As mentioned

earlier, there is plenty of evidence in favour of a cascaded view to lexical selection (Costa et al., 2005; Dell, 1986; Griffin & Bock, 1998; Harley, 1993; Rapp & Goldrick, 2000; Starreveld & La Heij, 1995).

Another feature of the Hybrid model's lemma stratum is interactivity between languages during bilingual language production. Like the Hartsuiker and Pickering (2008) model, the Hybrid model assumes similar lexical items and syntactic structures across languages are shared between languages. Recall that the evidence of this shared store comes from the multitude of studies conducted on cross-linguistic syntactic priming (Bernolet et al., 2007, 2009; Kantola & van Gompel, 2011; Loebell & Bock, 2003; Salamoura & Williams, 2006, 2007; Schoonbaert et al., 2007). In addition to this, the Hybrid model assumes that lexical items from one language can be produced using the syntactic structure from the other language. Evidence for this comes from experiments investigating production of nouns and adjectives in Spanish-English code-switching (Selles, 2011), from experiments investigating number agreement of verbs (Hatzidaki et al., 2011), and from experiments on gender agreement of possessive determiners (Anton-Mendez, 2011). In order to account for these findings, the Hybrid model takes a strong stance of cascaded activation from the lemma level to the word-form level. In addition, an important aspect of the Hybrid model is that the syntactic features of all activated lemmas also send cascading activation to the word-form level. This architecture of the lemma stratum has implications in the processing of determiners, pronouns, possessive pronouns, and possessive determiners during bilingual language production. The Hybrid model does not make specific claims, rather the model presents syntactic options available based on the architecture of the lemma stratum.

It is important to note that the way in which content morphemes, such as nouns and verbs, are produced may differ from the production of closed-class words. In the following sections I will discuss the way in which the Hybrid model accounts for the production of different closed-class elements.

2.3.2.4 Early and late morpheme distinction

Before discussing the production of closed-class elements, let us consider the early and late system morpheme distinction of the 4-M model, and how it fits within the framework of the Hybrid model. According to the 4-M model, outsider system

morphemes can only come from the ML because they require information from outside of its head constituent in order to receive its form. The Hybrid model acknowledges that certain morphemes are accessed at different stages during language production, but the model does not predict that this difference results in specific patterns of code-switching. Rather, the Hybrid model takes the stance that the preverbal message is language specific. If the preverbal message is encoded in one language that lacks features from the other language, those features that are not encoded from the preverbal message will not be available during code-switching.

2.3.2.5 *Closed-class production*

As discussed in earlier sections, the weakness of the Hartsuiker and Pickering (2008) model is the underspecified aspect of describing the production of closed-class words. If we extend the model's selection of content words towards the production of closed-class elements we see that the model does not fit with current theories of closed-class word production. The strength of the 4-M model is the classification of different morpheme types and the roles in which the morphemes play during language production. For the purpose of this thesis we look specifically at determiner selection and agreement processing.

2.3.2.5.1 *Determiners*

The Hybrid model's predictions are consistent with the account that lemmas compete for selection under a cascaded model (Dhooge et al., 2016). Cascaded models suggests that activated lemmas feed activation down to the word-form level. The Hybrid model predicts that features from the head noun activate featural nodes of the determiner. The activated featural nodes then feed activation down to the determiner forms at the word-form level. This mechanism of determiner selection allows for determiners to be produced in one language with the grammatical gender of the other language. For example, the word for *cat* in French is masculine, *le chat*, and feminine in German, *die Katze*. Under the Hybrid model, a French-German bilingual may produce the code-switched NP *le Katze* (see Figure 2). The lemma for *chat* activates the masculine feature node, and the lemma for *Katze* activates the feminine feature node. The masculine feature node is attached to the French language node and the feminine feature node is attached to the German language node. These feature nodes then send activation to the determiner lemma feature node, and

therefore both masculine and feminine feature nodes of the determiner are activated. If at the lemma level the German language node achieves a higher activation, then the *Katze* lemma becomes selected. Activation of the language node is dependent on the context of the discourse. If a proficient French-German bilingual is speaking to a native German speaker with a low proficiency in French, the German language node will receive a higher level of activation in comparison to the French language node. If the French language node and masculine feature node receives a higher level of activation at word-form level for determiner selection, then the French masculine determiner will be selected. In fact, code-switching between the determiner and noun does occur (Preziosa-Di Quinzio, 1992). Note that the Hybrid model also accounts for instances in which the code-switched NP is produced as *la Katze*, using a French feminine determiner. This NP would occur if at the word-form level the feminine feature node and French language node of the determiner reaches the highest level of activation.

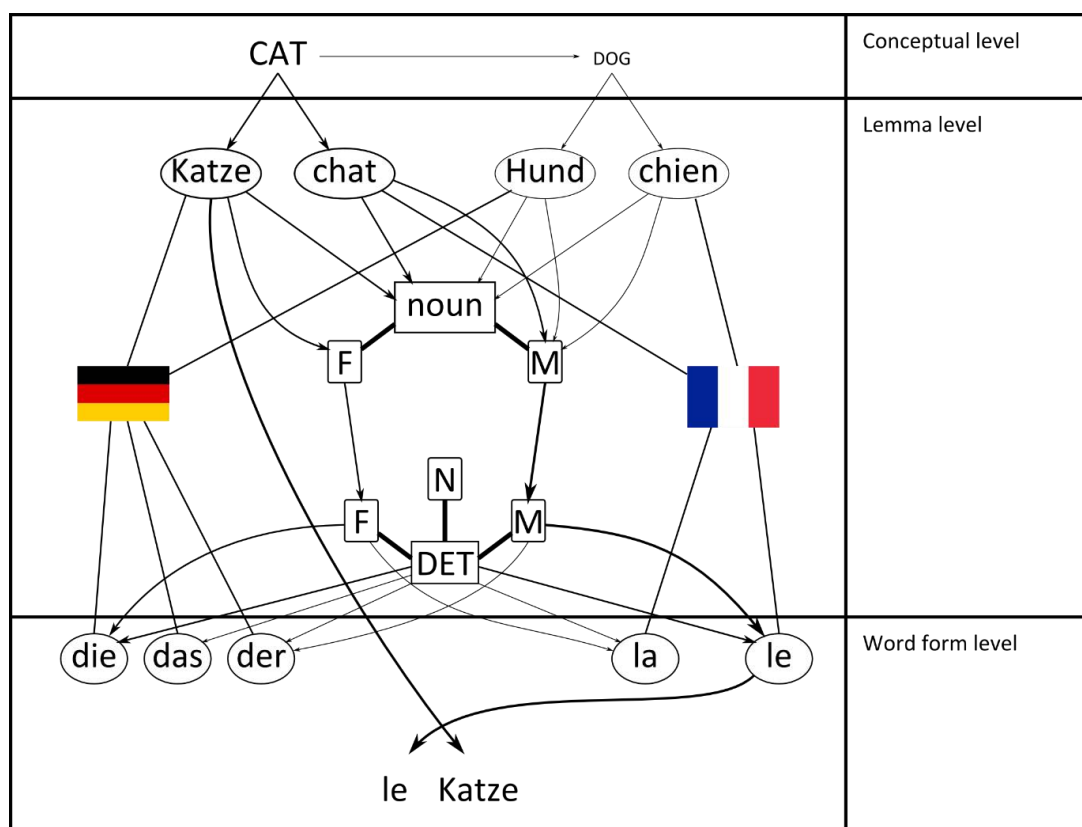


Figure 2. Hybrid model representation of determiner selection within a NP. The German flag represents the German language node and the French flag represents the French language node. The line thickness represents the amount of relative activation within the connection between nodes.

2.3.2.5.2 *Subject-verb agreement*

Some researchers consider subject-verb agreement to be a syntactic process (Franck, 2011; Levelt et al., 1999) but evidence supports the view that it is also influenced by conceptual features (Bock et al., 2004; Eberhard et al., 2005). The Hartsuiker and Pickering (2008) model is heavily influenced by the Pickering and Branigan (1998) model of monolingual language production. Findings from Pickering and Branigan (1998) showed that syntactic priming of DO or PO structures occurred regardless of tense, mood, or number of verb. These results suggest that verb lemmas hold the bare form of the verb and that subject verb agreement occurs after lemma selection. The Pickering and Branigan (1998) and Hartsuiker and Pickering (2008) models do not go into detail on how verbs receive their agreement information. In such a network model it is likely that tense, mood, and aspect are conceptual features that activate featural nodes of the verb lemma, and that person and number are activated from the grammatical features of the subject noun (Levelt et al., 1999). Experimental evidence from Hatzidaki et al. (2011) supports the view that verbs receive number information from the subject noun. In a code-switching paradigm, Hatzidaki and colleagues tested Greek-English and English-Greek bilinguals in verb agreement by forcing participants to code-switch after a target subject noun. In critical trials the subject nouns were either singular or plural, and their translation equivalents were the mismatched number; singular English nouns were plural in Greek and vice versa. The results showed that in code-switching trials, participants used verbs in one language that agreed with the syntactic properties of nouns in the other language.

The MLF model takes the same stance as the Pickering and Branigan (1998) and Hartsuiker and Pickering (2008) models that verbs are initially selected as base forms and the agreement suffixes (or word-form in the case of irregular verbs) are processed at a later stage during morphological encoding (Myers-Scotton, 1997, 2002; Myers-Scotton & Jake, 2000a). Subject verb agreement is said to be a late system morpheme because it requires information from the subject noun for person and number which is outside of the verb's head constituency. Mood, tense, and aspect are all available from the conceptual argument from the preverbal message

and therefore do not play a role making subject verb agreement a late outsider system morpheme.

The Hybrid model I propose also takes the same stance as the MLF model and the Hartsuiker and Pickering (2008) model in that verbs are initially selected in their base form. Temporal information such as tense, mood, and aspect are received from the conceptual level and person and number information are retrieved from the subject noun. The subject noun has separate feature nodes corresponding to the person and number features for the noun. These feature nodes then activate the person and number feature nodes of the verb lemma. During bilingual language production, if the subject lemma is represented by a singular noun in one language and a plural noun in the other language, both singular and plural number feature nodes will be activated. The coactivation of both singular and plural number feature nodes of the verb lemma is what leads to the findings in Hatzidaki et al. (2011). This process is competitive between languages, and the node that receives the highest level of activation is ultimately the feature that recruits the agreement suffix during morphological encoding.

2.3.2.5.3 Pronoun agreement

Pronoun agreement is also shown to have syntactic (Meyer & Bock, 1999; Navarrete & Costa, 2009; Schmitt et al., 1999) and conceptual influences (Antón-Méndez, 2010; Bock et al., 2004). The 4-M model does not treat all pronouns the same; some pronouns within the same language may be content morphemes and others may be system morphemes (Myers-Scotton & Jake, 2016). In English, all personal pronouns are content morphemes, but dummy pronouns such as *it* and *there* are system morphemes. For the processing of pronoun agreement, the 4-M model assumes that gender and number agreement features are assigned from the conceptual level (Myers-Scotton & Jake, 2016).

The Hartsuiker and Pickering (2008) model makes no specific claim for the way in which pronouns receive their agreement information. I assume the feature nodes of the antecedent noun activate the feature nodes of the pronoun lemma. The pronoun lemma that receives the highest level of activation is ultimately selected for production.

The Hybrid model I propose assumes that pronoun agreement is primarily a syntactic process. The pronoun lemma receives activation of its gender and number feature nodes from the gender and number features nodes of the antecedent lemma. Recall from the earlier review on pronoun agreement that for collective nouns, sometimes the pronoun agrees in conceptual number rather than grammatical number. It was also demonstrated that for languages with three grammatical genders such as Dutch and German, certain nouns are grammatically neuter and conceptually feminine. These nouns sometimes elicit agreement to conceptual gender rather than grammatical gender (Meyer & Bock, 1999). It was also demonstrated that conceptual features had a larger effect on agreement the larger the distance from the antecedent noun (Garnham et al., 1995; Schweppe, 2013). As discussed above, the Hybrid model assumes that conceptual features of number and gender also feed activation from the conceptual level to the lemma level, in turn activating the featural nodes of the target lemma. It is also assumed that activation from conceptual features achieves a longer residual activation than activation from syntactic features, allowing for agreement to continue over long linguistic distances.

During bilingual language production, it is assumed that the antecedent noun lemma activates the featural nodes corresponding to the features from both languages. These features then activate the featural nodes of the pronoun lemma. All activated featural nodes of the pronoun lemma activate the corresponding word-forms at the word-form level. It is the pronoun form with the highest activation that becomes selected for production. The architecture underlying pronoun production allows for pronouns in one language to be produced using the agreement rules of the other language.

2.3.2.5.4 Possessive pronouns

As outlined above, accessing agreement information from pronouns is a relatively straightforward process; the pronoun relies on agreement information from the antecedent noun whether it is syntactic or conceptual. Accessing agreement information of possessive pronouns and possessive determiners is more complex because different languages have different agreement rules. English possessive pronouns agree with the possessor noun whereas Spanish and French possessive pronouns agree with the possessed noun. Consider the example sentences below:

‘The pirate says the sister is his’.

‘El pirata dice que la hermana es suya’.

It is my interpretation of the 4-M model that the agreement morphemes for possessive pronouns of both English and Spanish are outsider system morphemes, because the information driving agreement falls beyond the projected NP of the possessive pronoun. Accordingly, during code-switching possessive pronouns may only come from the ML because they are late system morphemes.

The Hybrid model claims that during code-switching, agreement information in the form of gender and number featural nodes from the controller noun activates the gender and number featural nodes of the possessive pronoun. For instances in which both languages have agreement rules, both controller nouns will send activation via these featural nodes. Given the examples above, for Spanish-English bilinguals the possessive pronoun will receive activation from the featural nodes of the *pirate* lemma and the *sister* lemma. This in turn activates the masculine and feminine feature nodes of the possessive pronoun. These features then send activation down to the word-form level, activating the phonological form of each possessive determiner; *suya*, *suyo*, *his*, and *hers*. It is a competition for selection at the word-form level, and selection is determined by the level of activation for each form. The language feature node plays a large role in the activation of the appropriate possessive determiner form.

2.3.2.5.5 Possessive determiners

Like possessive pronouns, the retrieval of agreement information for possessive determiners differs depending on the agreement rules of the language. English possessive determiners agree with the possessor noun and French and Spanish possessive determiners agree with the possessed noun. Consider the examples below:

‘The pirate annoys his sister’.

‘Le pirate ennuie sa soeur’.

It is my interpretation of the 4-M model that possessive determiners are early system morphemes because they behave linguistically like other determiners. In the example provided above English possessive determiners are multimorphemic and behave as late system morphemes because the agreement information is outside of its

NP. English determiners are not always treated as late system morphemes. For example, in the sentence '*the pirate and his sister go to the market*', the possessive determiner is an early system morpheme because it is in the same subject NP as the noun governing agreement. For the purpose of this thesis we will be using examples in which the English possessive determiner falls outside of the NP of the noun that controls agreement.

The Hybrid model explains that possessive determiner agreement follows the same process as possessive pronoun agreement. The featural nodes of the controller noun lemma send activation to the feature nodes of the possessive determiner lemma. The activated feature nodes then send activation to the word-form level, activating the appropriate phonological form of the possessive determiner. The same process occurs during bilingual language production. If the two languages follow different agreement rules, then the featural nodes of both controller nouns send activation to the featural nodes of the possessive determiner. For our examples above, the masculine featural node from the *pirate* lemma and the feminine featural node from the *sister* lemma will activate both masculine and feminine feature nodes of the possessive determiner. These features then send activation to the word-form level, activating the forms *son*, *sa*, *his*, and *her*. The form with the highest level of activation will be selected, with the language node playing a role in which language the possessive determiner form will be selected.

2.3.2.5.6 Case-marking

According to the 4-M model, case-marking is said to require information from outside of its head constituent to retrieve its form (Myers-Scotton, 2002; Myers-Scotton & Jake, 2000a). In German, determiners and adjectives are marked for case. Typically determiners are early system morphemes; they are accessed early in language production because they are indirectly elected by their noun head. Determiners that are marked for case are called multimorphemic, because while the determiner is an early system morpheme, case-marking is a late system morpheme. The Hybrid model assumes determiners receive their case information in the same manner as they receive gender and number information, via links to the featural nodes of the head noun.

2.4 Summary of experimental chapters

In the following experimental chapters I will be testing different aspects of the Hybrid model against the MLF model. In Chapter 3 I explore the architecture of the lemma stratum as described by the Hybrid model. Using a code-switching paradigm I investigate whether lexical items from one language can be produced using the syntactic structure of the other language. In a forced code-switching paradigm, Selles (2011) forced native Spanish speakers to switch from English to Spanish or from Spanish to English before producing a NP with an adjective. The results showed that native Spanish speakers had a tendency to produce Spanish NPs with adjectives using the English prenominal word order. Chapter 3 looks to extend these findings in a similar paradigm, but by restricting the type of adjective participants use in their utterances.

Chapter 4 further explores the Hybrid model's lemma stratum and its prediction that lexical items from one language can be produced using the syntax of the other language. Using a code-switching task involving the production of English and Spanish possessive pronouns I look to see whether speakers will produce pronouns from one language while using the agreement rules of the other language.

Chapter 5 again looks at the lemma stratum using a code-switching paradigm involving the production of English and French possessive determiners. One further manipulation in this chapter is that, according to the 4-M model, English possessive determiners are treated as late outsider system morphemes because the agreement information falls outside of its NP whereas French possessive determiners are treated as early system morphemes because the agreement information is within its NP. Of specific interest in this chapter is whether there are any differences between the processing of English and French determiners because of their early and late system morpheme distinction.

In Chapter 6 I look at the processing of German case-marked determiners in German-English code-switching. The Hybrid model makes no specific claims in regards to how case-marking is processed. The 4-M model states that case-marking is an outsider system morpheme (Myers-Scotton & Jake, 2000a, 2000b). The MLF model states that outsider system morphemes can only come from the ML (Myers-Scotton, 2002). Chapter 6 tests these predictions.

Chapter 3

An investigation of word order in the production of nouns and adjectives in Spanish-English code-switching

3.0 Chapter overview

The purpose of this chapter is to review previous research that demonstrates instances in which bilingual speakers use syntactic rules of one language with lexical items of the other language. I will then discuss how these findings are consistent with the Hybrid model I proposed in the previous chapter. Finally, I report an experiment conducted to further test the separation of lexical selection from syntactic processes.

3.1 Separation of lexical selection and syntactic processes

3.1.1 Agreement

Results from previous experiments on agreement processing of bilinguals have shown that lexical items in one language are sometimes produced using the syntactic structure of the other language. Antón-Méndez (2011) investigated how native Italian, native Spanish, and native Dutch speakers use English gender agreement for possessive determiners. In Italian the possessive determiner agrees in gender with the possessed noun whereas in English the possessive determiner agrees in gender with the possessor noun. In Spanish, the third person singular possessive determiner is not marked for gender, but because determiners in Spanish are marked for gender it might be expected that Spanish speakers would process Spanish possessive determiners in the same way as in Italian. The Dutch speakers were used as a control group because gender agreement of Dutch possessive determiners follows the same rules as English. Participants were presented with a picture displayed in the top left corner of the screen. In the singular condition the picture was of a female or a male character, in the plural condition the picture was of a group of people. The participants were also shown a possessive sentence and were told that the person or group of people in the picture said the sentence. The task was for the

participants to retell the sentence that was shown. For example, the participants were shown a picture of a female character and the sentence, “*My father gets a new position in another department*”. The participants were expected to retell the sentence as “*Her father got a new position in another department*”. In the singular condition the gender of the character in the picture and the gender of the subject of the sentence were either matched or mismatched. The Italian and Spanish speakers made more agreement errors than the Dutch speakers, and these errors occurred mostly in the mismatched gender condition. Italian speakers made gender agreement errors in English that followed the gender agreement rules of Italian. Spanish speakers made the same pattern of mistakes as the Italian speakers. Antón-Méndez (2011) argued that it is likely that Spanish speakers still access gender information of the possessed noun even though there is no gender marked third person possessive determiner. Critically, at least for Italian speakers the results showed that participants produced L2 words using L1 syntactic structure.

In an experiment investigating verb agreement, Hatzidaki et al., (2011) found English-Greek and Greek-English speakers were sensitive to the syntactic features of nouns whose translation equivalent was divergent in number agreement. In the study participants performed a sentence completion task in which they were sometimes asked to code-switch after a critical noun. The critical noun was singular in one language and plural in the other language. The results showed that when switching languages, the syntactic features of the source language remained activated, influencing the verb agreement of the target language. For example, English-Greek bilinguals would say ‘*τα λεφτά are*’, (*the money are*) when the Greek noun for *money*, *λεφτά* is syntactically plural. Interestingly, this effect also occurred in trials that did not require code-switching, though both languages were in use during the experimental session. The authors concluded that there was residual activation at the syntactic level from when the other language was last used, leading to verb agreement that was influenced by the language not in use. In other words, participants were responding in one language using the agreement features provided by the other language, even when the other language was not active during the utterance.

3.1.2 Word order

Evidence supporting the separation of lexical selection from syntactic structure predicted by the Hybrid model comes from an experiment investigating word order differences of adjective and noun strings in English and Spanish. In an unpublished Masters dissertation, Selles (2011) tested native Spanish speakers in a sentence completion task. Participants were given a sentence fragment and were asked to repeat the fragment and complete the sentence by naming an object depicted in the picture. Participants were also asked to use any adjective when naming the picture depending on the qualities of the object. For example, participants will be shown the sentence fragment ‘the boy eats the’ and a picture of a red apple. The expected response is ‘the boy eats the red apple’. In English, adjectives are produced before the noun they modify (e.g., *the red apple*) whereas in Spanish the adjectives are produced after the noun they modify (e.g., *la manzana roja*).

In the experiment participants were presented with sentence fragments in Spanish or English, and the objects were named in Spanish or English. That is, one quarter of trials were Spanish fragments with Spanish completions, one quarter of trials were English fragments with English completions, one quarter of trials were English fragments with Spanish completions, and one quarter of trials were Spanish fragments with English completions. Critically, in the code-switched trials participants were switching language before the production of the final modified NP. The results were somewhat surprising, the native Spanish speakers were significantly more likely to use the English word order when switching from English to Spanish than they were to use the Spanish word order when switching from Spanish to English. This was not an effect of using L1 syntax with L2 words, but rather an effect of using L2 syntax with L1 words. Spanish has a few adjectives that can only occur prenominally, such as *mero* (mere), and *supuesto* (alleged), but these prenominal adjectives occur very infrequently. Spanish also allows prenominal adjectives for meaning-changing adjectives. For example, *viejo amigo* (old friend) refers to a long-time friend whereas *amigo viejo* (friend old) refers to a friend who is old in age. Adjectives that can only be placed prenominally account for less than 1% of adjectives used in Spanish, meaning changing prenominal adjectives account for 12% of adjectives used in Spanish, and postnominal adjectives account for 69% of

adjectives used in Spanish (de Nicolás & Robledo, 2017). Because Spanish allows for a small set of prenominal meaning-changing adjectives, it was possible the prenominal adjectives used in the experiment may have been meaning-changing as well. However, it was clear from the responses that the participants in Selles (2011) did not use adjectives as meaning-changing adjectives when responding with prenominal Spanish adjectives. For example, “oscura cueva” *dark cave*, “grande hombre” *big man*, are among the prenominal adjective completions from the study that are not consistent with meaning-changing adjectives in Spanish.

The results were explained in terms of the Hartsuiker and Pickering (2008) model of bilingual language production. During monolingual English production of modified noun phrases, the combinatorial node that controls the word order of adjective and nouns places the adjective before the noun. During monolingual Spanish production of modified noun phrases, the combinatorial node that controls the word order of adjective and noun places the adjective after the noun for regular usage of adjectives. For meaning-changing adjectives, there is a combinatorial node that places adjectives before the noun. In other words, Spanish has two combinatorial nodes for modified noun phrases, noun+adjective for typical instances and adjective+noun for meaning-changing instances. Because of this, Spanish-English bilinguals share the adjective+noun combinatorial node between English and Spanish language nodes, whereas the noun+adjective combinatorial node is only attached to the Spanish language node. During the course of the experiment, the adjective+noun combinatorial node sometimes received higher activation and was used for Spanish completions of typical adjective usage. Because this word order was not used for meaning-changing adjectives, it may suggest that lexical selection occurs separately from the selection of syntactic structures.

Experiment 3.1

Production of adjectives in noun phrases: An investigation of word order in Spanish-English code-switching

3.2 Rationale

In order to replicate the effects found in Selles (2011), I attempted to elicit prenominal adjectives in Spanish completions using a strict control on adjectives. This strict control on adjectives was used in order to limit the Spanish adjectives to the standard postnominal word order (e.g., *la manzana roja/the apple red*). Controlling the adjectives so that in Spanish they only occur in the postnominal position assures that the noun+adjective combinatorial node and the adjective+noun combinatorial node receive the same amount of activation throughout the experimental session. Whereas Selles (2011) allowed speakers free control over the adjectives they used in production, the current experiment attempts to replicate the results with only using colour as adjectives.

3.2.1 Predictions

For the current experiment, based on the findings from Selles (2011), the Hybrid model predicts that native Spanish bilingual speakers will produce prenominal adjectives in Spanish when switching from English to Spanish at the final NP. This prediction is consistent with the architecture of the lemma stratum assumed by the Hybrid model. That is, both combinatorial nodes controlling the word order of nouns and adjectives will be activated; the adjective+noun combinatorial node for English, and the noun+adjective combinatorial node for Spanish. Because Spanish also allows for meaning-changing adjectives to come before the noun, it is predicted that there will be slight activation from the adjective+noun combinatorial node in Spanish as well. Because the adjective+noun combinatorial node has links from both languages, the Hybrid model predicts some speakers will respond in Spanish with the colour adjective coming before the noun. Please note that the Hybrid model does not make exact predictions of what speakers will produce, but offers an explanation for the possible outcomes.

The current experiment also tests the MLF model predictions. According to the MLF model, during switch trials speakers will be producing the modified noun phrase as an EL Island. Because of this, the MLF predicts that speakers will produce adjectives in the correct word order. Please note that the experimental task makes use of a language prompt to cue participants to switch languages. The purpose of the

language prompt is to force participants into switching languages at a specific point in the sentence in order to test how speakers resolve instances in which the two languages have different syntactic rules. One caveat to this type procedure is that it is not a true test of natural code-switching and may not be a suitable test of the MLF model. However, this methodology was used as a controlled method to test the difference in adjective word order between English and Spanish.

3.3 Method

3.3.1 Participants

Twenty-four native Spanish speakers (16 female, 8 male) were recruited from the George Square campus of the University of Edinburgh. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of English in order to participate. The participants had a mean age of 22.3 years ($SD = 1.46$) and reported having an average of 8.7 years of English language experience. Participants were given a self-rated questionnaire prior to testing for their English production, reading, and writing skills. On a five point scale, the participants averaged 4.33 in production, 4.17 in reading, and 4.13 in writing skills for an overall average proficiency score of 4.21. Participants were also given a language demographic questionnaire. Of the 24 participants 12 speak or are learning to speak a language in addition to Spanish and English. Twenty-two participants speak Spanish as their main language at home and only two speak English as their main language at home. Finally, 15 of the 24 participants reported speaking English regularly at home. The participants spent an average of 2.7 years ($SD = 1.92$) in an English speaking country prior to testing. Participants received four British Pounds for their participation in this study.

3.3.2 Stimuli materials

Conditions		
Source Language	Target	Example
English	English	The child eats... the yellow apple
Spanish	Spanish	El niño come... la manzana amarillo
English	Spanish	The child eats... la manzana amarillo
Spanish	English	El niño come... the yellow apple

Experimental items were created by pairing sentence fragments with pictures of coloured objects. Forty-eight unique sentence fragments were created by removing the final NP of transitive sentences (e.g., *the dog chases...*). Pictures of 48 different coloured objects were chosen to replace the final NP of the sentence fragments (e.g., picture of a red ball). The sentence fragments were translated into Spanish to create two sets of 48 sentence fragments. The pictures were then duplicated forming two sets, giving one set a square border and the other set a circular border. Selles (2011) used a coloured square border to act as a language prompt, but because the current experiment used coloured objects to elicit adjectives, the language prompt was changed. The shape of the border around the picture acted as the language prompt, the square border instructing participants to name the picture in the same language, and the circular border instructing participants to switch languages.

Four language versions of the experimental items were created. An English-English version was created with the English sentence fragments and the pictures with a square border. The Spanish-Spanish version was created with the Spanish sentence fragments and the pictures with the square border. The English-Spanish version was created with the English sentence fragments and the pictures with the circular border. The Spanish-English version was created with the Spanish sentence fragments and the pictures with the circular border. The experiment used a Latin square design; four lists were created using 12 unique items from each language version making a total of 48 experimental items per list. Filler items were created in a similar manner as the experimental items with the exception of the pictures which depicted multiple objects. There were 96 filler items and 48 experimental items making a total of 144 items.

3.3.3 Procedure

Prior to testing, participants filled out a demographic questionnaire including a self-evaluation of their English proficiency. Instructions for the experimental task were presented entirely in English. The experiment was a sentence completion task in which participants were presented with a sentence fragment and a picture. The participants were asked to repeat the sentence fragment out loud and complete the sentence by describing the object in the picture by its colour. Participants were

instructed to read the sentence fragment in the same language that it was presented, and to complete the sentence in the same language if the picture had a square border, or to switch languages if the picture had a circular border (see Figure 3). Participants were given twelve practice trials prior to the test trials to become familiar with the task and the language prompts. Each trial began with a fixation point in the middle of the screen for 500 milliseconds. The sentence-picture pair then appeared for 6000 milliseconds, allowing enough time for the participants to respond. The participants responded into a microphone and the audio recordings were saved onto the computer.

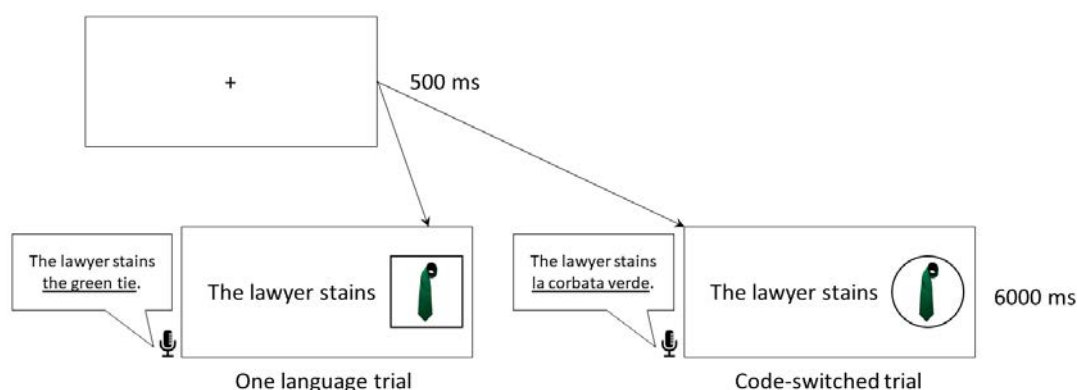


Figure 3.

3.3.4 Coding

The responses were coded into three different categories. Responses in which participants produced the word order consistent with the syntax of the target language were coded as 0. In other words, responses in which participants produced nouns before adjectives in Spanish and responses in which participants produced adjectives before nouns in English were coded as 0. Responses in which participants produced the word order inconsistent with the syntax of the target language were coded as 1. In other words, responses in which participants produced adjectives before nouns in Spanish and responses in which participants produced nouns before adjectives in English were coded as 1. Responses were coded as NA for all other responses which included forgetting to use an adjective, responding in the wrong target language, as well as a failure to respond at all.

3.4 Results

In the entire experiment there were only three responses that were inconsistent with the word order of the target language (see Table 1). For such small number of inconsistent word order responses it was deemed not necessary to conduct statistical analysis. Recall that the Hybrid model predicts that native Spanish speakers are likely to produce adjectives before nouns in Spanish more often than they produce nouns before adjectives in English. Given that fewer than one percent (0.3%) of all valid responses are inconsistent responses, and that only 1.3% of valid responses in the critical condition were inconsistent responses it is safe to assume that the results are not significant.

Table 1.

Results					
Conditions			Responses		
Source Language	Target Language	Language Condition	Consistent	Inconsistent	NA
English	English	One-Language	278	0	10
Spanish	Spanish	One-Language	280	0	8
English	Spanish	Two-Language	264	3	21
Spanish	English	Two-Language	263	0	25

3.5 Discussion

The current experiment showed that participants responded in the word order expected by the target language. That is, participants responded with adjectives before nouns when completing the sentence in English, and with nouns before adjectives when completing the sentence in Spanish. The results were consistent with the predictions of the MLF model, but were not consistent with the predictions of the Hybrid model. In addition, the results were not consistent with the results from Selles (2011). Upon further review of the method of the current experiment, it is possible that restricting participants to respond with colour adjectives is the reason for the discrepancy between the current experiment and Selles (2011). In Selles (2011) participants were given full control over which adjective they were able to use depending on the qualities exhibited in the pictures provided. This allows both noun+adjective and adjective+noun combinatorial nodes in Spanish to become

activated. Even though meaning-changing adjectives were not used for responses in Selles (2011), it was likely that both combinatorial nodes were activated because the speakers did not know what adjectives they would have to use, or in which language they were required to respond until the picture was displayed. In the current experiment however, participants did not know the language in which they had to respond but they knew they would only have to describe the object in the picture with a colour. The use of colour as the only adjective allowed the participants to plan their utterance accordingly.

The Hybrid model assumes that the combinatorial nodes for adjectival word order are connected to the adjective and to the language node. For English, the language node will only be connected to the adjective+noun combinatorial node, but for Spanish the language node will be connected to both adjective+noun and noun+adjective combinatorial nodes. With connections between the language node and the adjectival word order combinatorial nodes, there can be instances in which Spanish speakers produce prenominal adjectives even when they are not meaning changing adjectives. If only the adjective was connected to the adjectival word order combinatorial nodes then only meaning changing adjectives could be produced prenominally. This structure can explain the results from the current experiment and from Selles (2011).

I also propose a mechanism for the Hybrid model to explain the way Spanish speakers produce meaning changing adjectives. The word *viejo* (old) is a Spanish adjective that changes meaning depending on whether it is prenominal or post nominal. When speakers use *viejo* to refer to age, conceptual activation from the conceptual level will send activation down to the noun+adjective combinatorial node at the lemma level. When speakers use *viejo* to refer to a friend they had for a long time, conceptual activation from the conceptual level will send activation down to the adjective+noun combinatorial node to trigger the meaning changing word order.

In an experiment investigating the planning scope of adjective use in English and Spanish NPs, Brown-Schmidt and Konopka (2008) found English speakers fixated on a contrast picture earlier than Spanish speakers who produced the same expression in Spanish. Because English requires the adjective before the noun, it was

argued that the English speakers had to encode the modifying information before the Spanish speakers, who produced the adjectives after the noun. Considering this finding, an additional factor that may have contributed to the results in Selles (2011) is that the speakers first had to encode the modifying information before the noun regardless of the target language because English target language responses always require prenominal adjectives and Spanish target language responses may sometimes require prenominal meaning-changing adjectives. Simply put, in Selles (2011) participants encoded modifying information prior to the noun regardless of the target language, and therefore the modifying information was available even when the target language was Spanish. Conversely, in the current study speakers only had to use colour as a modifier which has a strict postnominal word order in Spanish. Because of this, speakers only had to encode modifying information before the noun when the target language was English, and they were able to encode the noun before the modifying information when the target language was Spanish.

3.6 Chapter summary

The current experiment attempted to replicate the results from Selles (2011) who found native Spanish speakers used L1 words in the L2 word order. The results were not consistent with Selles (2011) and did not follow the predictions I set for the Hybrid model. This however does not provide evidence against the Hybrid model's proposal that lexical selection and syntactic processing can occur separately. Rather, the nature of the current experiment did not satisfy the conditions needed for speakers to use lexical items from one language in the syntactic structure of the other language. Namely, the use of colours in the current experiment did not activate the adjective+noun combinatorial node to a high enough extent to elicit prenominal adjectives in Spanish.

Chapter 4

An investigation of gender agreement of Spanish and English possessive pronouns

4.0 Chapter overview

In this chapter I review the literature on pronoun agreement. Although the literature I review in this chapter investigates both number and gender agreement of pronouns, the emphasis for this current chapter is on gender agreement. After reviewing the literature on pronoun agreement, I discuss how the research implications are applied to possessive pronouns. Specifically I discuss the implications for the processing of gender agreement for English and Spanish possessive pronouns. Of particular interest is how the different syntactic rules regarding agreement of possessive pronouns affect the ways in which possessive pronouns are used during code-switching. I then summarise the predictions of the Hybrid model and the MLF model. To investigate these predictions I conducted two experiments that I report in this chapter. Experiment 4.1 investigated production of possessive pronoun agreement during code-switching with English-Spanish bilinguals, and Experiment 4.2 investigated Spanish-English bilinguals.

4.1 Theoretical grounds

The Hartsuiker and Pickering (2008) model describes the process of selecting content morphemes, specifically nouns and verbs, and the syntactic structures tied to these lemmas. The model also describes the ways in which bilingual language production follows a competitive selection process between lexical items and syntactic structures of both languages. The model however is underspecified for describing the ways in which lemmas underlying closed-class items are activated and selected. The purpose of the Hybrid model is to give an adequate account of open and closed-class production as well as accounting for lexical and syntactic selection from both languages during bilingual language production.

4.1.1 Pronoun agreement

The literature on pronoun production shows evidence supporting the views that both conceptual and grammatical features of the antecedent noun play a role in pronoun agreement. Pronoun gender has a tendency to agree with the grammatical gender of the antecedent noun (Navarrete & Costa, 2009; Schmitt et al., 1999) unless the language lacks the grammatical gender of nouns (Antón-Méndez, 2010). For both number and gender agreement, pronouns tend to agree with the grammatical features of the antecedent noun when there is a short distance between the antecedent noun and the pronoun. At longer distances between the antecedent noun and the pronoun, agreement tends to follow conceptual features (Garnham et al., 1995; Meyer & Bock, 1999; Schweppe, 2013). For example, in German the noun '*Mädchen*' (girl) is neuter but conceptually feminine, so if '*Mädchen*' is the antecedent noun speakers are likely to use neuter pronouns at short distances and likely to use feminine pronouns over larger distances.

4.1.2 Possessive pronouns

Little research has been done on agreement of possessive pronouns. The Hybrid model assumes that possessive pronoun agreement is carried out in a similar manner as pronoun agreement. The Hybrid model takes the stance that at the lemma level, the featural nodes of the controller noun's lemma sends activation to the featural nodes of the possessive pronoun lemma. The possessive pronoun lemma and its featural nodes then send activation down to the word-form level in which the target possessive pronoun form is selected. However, this issue raises questions because languages have different agreement rules regarding which noun contributes to possessive pronoun agreement. In English, possessive pronouns agree in person and number with the possessor noun, and third person possessive pronouns also agree in gender with the possessor noun. English possessive pronouns do not agree with the possessed noun. In French and Spanish, possessive pronouns agree in number and gender with the possessed noun and in person and number with the possessor noun. There are different stems depending on the person and number of the possessor noun, and different suffixes depending on the gender and number of the possessed noun. German possessive pronouns have different stems depending on the

gender of the possessor and different suffixes depending on the gender of the possessed noun: *sein* for a masculine possessor of a masculine or neuter noun, *ihr* for a feminine possessor of a masculine or neuter noun, *seine* for a masculine possessor of a feminine noun, and *ihre* for a feminine possessor of a feminine noun. Possessive pronouns are more likely to refer to an animate possessor than an inanimate possessor. This again leads to the question (for languages that depend on the possessor noun for agreement), does possessive pronoun agreement rely on syntactic or conceptual gender of the controller noun? For the purpose of the Hybrid model, the focus is not on whether agreement follows conceptual or syntactic features, but instead how the different agreement rules across languages interact during code-switching. In the following sections I report two experiments that investigate how English and Spanish possessive pronouns are used during code-switching. I will discuss the implications of the different agreement rules between English and Spanish and I will review the predictions of the different production models.

Experiment 4.1

English-Spanish code-switching of possessive pronouns

4.2 Rationale

The current experiment investigates the production of possessive pronouns. The Hybrid model takes the stance that agreement for possessive pronouns follows a similar mechanism as agreement for pronouns. As mentioned previously, this proposal is not straightforward. Languages differ with regards to which noun is responsible for agreement of possessive pronouns. In this chapter I investigate the production of English and Spanish possessive pronouns, and how agreement rules interact during code-switching. My proposed Hybrid model follows a similar shared syntax account as the Hartsuiker and Pickering (2008) model. Furthermore, the Hybrid model assumes a separation between lexical and syntactic selection that allows lexical items of one language to be used with the syntactic structure of the other language. Under this account the gender features of both the English and Spanish controller nouns activate the gender feature node of the possessive pronoun. From the activated gender feature nodes of the possessive pronoun, the available word-forms become activated. When both English and Spanish controller nouns are

the same gender, only one gender node becomes activated, ultimately activating the word-form of the English and Spanish possessive pronouns for that gender. Additional activation from the target language node leads to the selection of the target language possessive pronoun form. When both English and Spanish controller nouns are of different genders, both masculine and feminine gender feature nodes of the possessive pronoun lemma become activated. In turn, all four word-forms become activated with the target language sending more activation through the language node which increases activation of the word-forms in that language. It is assumed that the gender agreement features from the correct controller noun receives the highest level of activation by default. However, this activation flow may be affected by a number of factors, such as the speaker's native language, their second language proficiency, and the salience of competing controller nouns. Consider the following example of an incongruent gender agreement completion in a code-switched sentence: "*the pirate says the sister es suyo*". In this example, the masculine node received the highest level of activation and with the increased activation through the Spanish language node the incongruent possessive pronoun *suyo* was selected.

Another account of possessive pronoun agreement comes from the MLF model. Recall that the MLF model is a production model of code-switching which relies on the four morpheme distinction of 4-M model. When referring to morpheme types I will be discussing the 4-M model, and when referring to language production I will be discussing the MLF model. According to the 4-M model, both Spanish and English possessive pronouns are late system morphemes. English possessive pronouns agree in gender with the possessor of the noun, which in our experiment is the first subject NP, and also this makes the agreement take place beyond the NP of the possessive pronouns. Speaking in terms of the 4-M model, because the English possessive pronoun requires information from outside of its head constituency for the agreement, the English possessive pronoun is a late system morpheme. Spanish agreement rules are different, the possessive pronoun requires information from the possessed noun, which in the example in Figure 4 is the subject NP of the embedded sentence. Like English possessive pronouns, the information needed for agreement falls beyond the NP of the possessive pronoun, thus also making Spanish possessive

pronouns late system morphemes. The possessive pronouns from English and Spanish are both late system morphemes, and this has implications for the MLF model. The MLF model states that late system morphemes can only come from the ML. In other words, because of the agreement rules of the possessive pronouns in English and Spanish, during code-switching these possessive pronouns can only come from the ML.

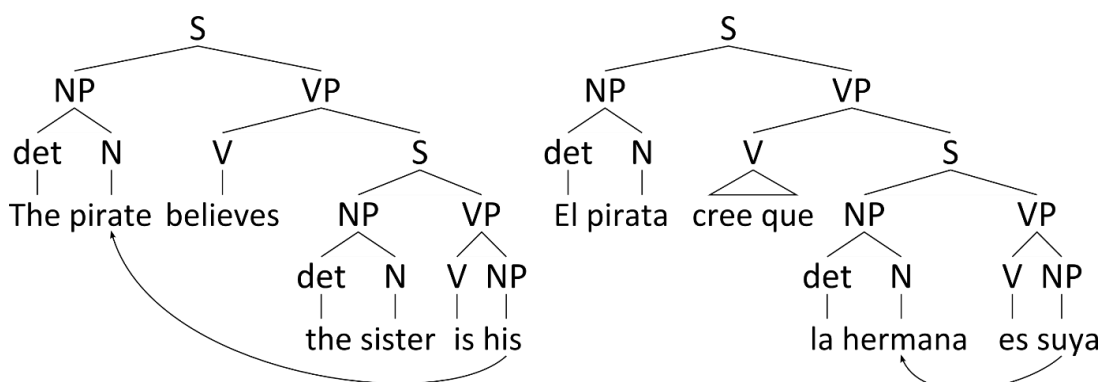


Figure 4.

The current experimental paradigm is a sentence completion task in which participants are shown an image of a subject character, the direct object character, and a verb. Participants are asked to form a complete sentence with the verb by indicating that the direct object character is a family member of the subject character, and to indicate this by using a possessive pronoun (e.g., ‘*the ballerina says the sister is hers*’, see Figure 5). The character on the left represents the subject; there are eight subject characters that represent a stereotypical gender role such as pirate and ballerina. There are four male and four female subject characters. The character on the right represents a family member that belongs to the subject character; there are four male and four female family members. The verb either represents certainty or doubt that the family member belongs to the subject. The following is example of an experimental utterance, in response to the prompt ‘*The pirate believes the sister...*’: ‘*The pirate believes the sister... is his*’. Trials have subject and family member genders that match (male subject paired with male family member, and female subject paired with female family member) or mismatch (male subject paired with female family member and female subject paired with male family member). By eliciting code-switching after naming the family member during mismatched gender

trials we can see whether participants show any tendency to use the gender agreement from the source language or from the target language.

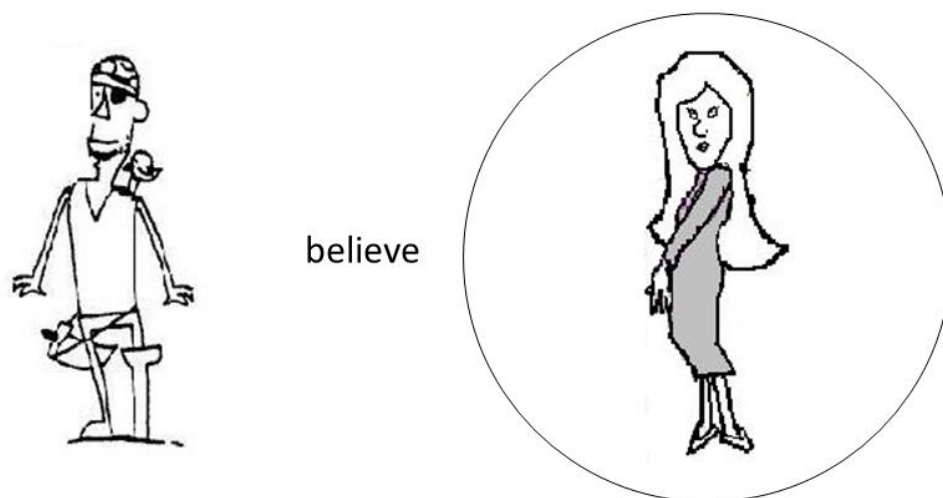


Figure 5.

4.2.1 Predictions

The Hybrid model is concerned with the coactivation of both agreement rules during production. During code-switching, the agreement rules from both languages will become activated through the lemma of the possessive pronoun. This means that for English, the agreement information from the initial subject noun, in the form of the featural nodes, will remain activated and will link to the featural node of the lemma of the possessive determiner. At the same time, the agreement information of the subject noun from the embedded sentence will also activate the featural node of the possessive pronoun. For cases in which the gender from both nouns is the same, only one gender feature node on the lemma of the possessive pronoun will become activated (residual activation from previous sentences may cause the other gender node to remain slightly activated). For cases in which the gender from both nouns is different, both gender nodes of the lemma of the possessive pronoun will become activated, leading to a competition for selection. Ultimately the gender node with the highest activation will become selected for production. The architecture of the lemma stratum of the Hybrid model allows for lexical items of one language to follow the syntactic rules of the other language. The Hybrid model predicts that in the gender mismatching condition, participants will use Spanish possessive pronouns following English gender agreement rules, and English possessive pronouns

following Spanish gender agreement rules. This prediction was also supported by Antón-Méndez (2011) who found Italian speakers used English possessive determiners that followed Italian gender agreement rules (as discussed further in the General Discussion below). Recall that the Hybrid model does not predict the utterance the speakers will use.

In addition to testing the Hybrid model, the current experiment also looks to test the MLF model. As noted in the previous section, the gender agreement rules for possessive pronouns make the possessive pronouns in Spanish and English late system morphemes. The MLF model states that late system morphemes are limited to the ML. The experimental items are manipulated to assure that the source language of the utterance is the ML. This was done by presenting the verb of the sentence in the third person singular in the present tense. Recall that under the 4-M model subject verb agreement is a late system morpheme because it requires information from the subject noun for agreement information, and the subject noun occurs outside of the VP. In English the third person singular present tense is the only verb conjugation that requires agreement information from the subject noun. Spanish has a rich verb morphology, so this manipulation results in both English and Spanish becoming the ML when they are presented as the source language. Strictly speaking, the models predict that when a speaker switches from the source language to the target language, the possessive pronoun should be produced from the ML. However, with the current task speakers are forced to switch languages at the final NP. In anticipation that participants will switch languages for the entire NP, the possessive pronoun and the noun, we will examine the degree to which the agreement features are available from either language because the agreement features in both English and Spanish fall outside of the maximal projection of the possessive pronoun. In addition, similar to Experiment 3.1 the current experiment does not use natural code-switching and therefore may not be suitable for testing the MLF model.

4.3 Method

4.3.1 Participants

Twenty native English speakers (13 female, 7 male) were recruited from the George Square campus of the University of Edinburgh. We tested English speakers

in Experiment 4.1 and Spanish speakers in Experiment 4.2 to examine if native language plays a role in switching patterns. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of Spanish in order to participate. The participants had a mean age of 22.2 years ($SD = 1.46$) and reported having an average of 7.7 years of Spanish language experience. Prior to running the experiment, participants were given a self-rated proficiency questionnaire for their Spanish production, reading, and writing skills. On a five point scale, the participants averaged 4.20 in production, 3.85 in reading, and 3.80 in writing skills for an overall average proficiency score of 3.95. Participants were also given a language demographic questionnaire. Of the 20 participants 9 speak or are learning to speak a language in addition to English and Spanish. Ten participants reported living in a Spanish speaking country. All 20 participants speak English as their main language at home. Finally, five of the 20 participants reported speaking Spanish at home. Participants received six British Pounds for their participation in the study.

4.3.2 Stimuli materials

Conditions			
Gender Matching	Source Language	Target Language	Example
Match	English	English	The pirate believes the brother... is his
Mismatch	English	English	The pirate believes the sister... is his
Match	Spanish	Spanish	El pirata cree que el hermano... es suyo
Mismatch	Spanish	Spanish	El pirata cree que la hermana... es suya
Match	English	Spanish	The pirate believes the brother... es suyo
Mismatch	English	Spanish	The pirate believes the sister... es suya
Match	Spanish	English	El pirata cree que el hermano... is his
Mismatch	Spanish	English	El pirata cree que la hermana... is his

The experimental items were created by displaying an image of two characters on a computer screen with the infinitive form of a verb in the middle of the screen between the two characters. The character on the left was the subject character. There are eight subject characters that represent a stereotypical gender, four male and four female. The character on the right was the family member. There are eight family members that represent four males and four females. Sixteen English verbs were used to indicate either assurance, doubt, or a remark that the family

member belonged to the character (e.g., think, doubt, say) were translated into Spanish. A square border around the image of the family member indicated participants were to complete the sentence in the language represented by the verb. Code-switched trials were elicited by presenting a circular border around the image of the family member. Participants were told to switch languages after naming the family member (see Appendix B).

Four versions of the experimental items were created. An English-English version consisted of a subject image, an English verb, and a family member image with a square border. A Spanish-Spanish version consisted of a subject image, a Spanish verb, and a family member image with a square border. An English-Spanish version consisted of a subject image, an English verb, and a family member image with a circular border. A Spanish-English version consisted of a subject image, a Spanish verb, and a family member image with a circular border. The experiment used a Latin square design; four lists were created using 16 unique items from each language version making a total of 64 experimental items per list. Filler items were created using a subject character and four English intransitive verbs indicating a reaction (smile, laugh, cry, and yell); filler verbs were translated into Spanish. A square border around the subject image prompted participants to name the subject character in the same language as the verb, a circular border around the subject image prompted participants to name the subject using the other language. There were 64 filler items making a total of 128 trials.

4.3.3 Procedure

Before the experiment participants filled out a demographic questionnaire asking participants for how long they started learning Spanish and to rate their Spanish verbal, reading, and writing skills out of five. The experiment was a sentence completion task in which participants used images of characters and a visually presented verb to construct a sentence. Instructions were presented all in English. Each trial began with a fixation point that was presented for 500 ms followed by a blank screen for 500 ms. Participants were then presented with two images and the infinitive form of a verb in between the two images. The image of the subject character always appeared on the left and the image of the family member

always appeared on the right. Participants were asked to begin the sentence by naming the subject character. Possessive pronouns were elicited by asking participants to complete the sentence indicating that the family member belonged to the character (e.g., the pirate thinks the brother *is his*). A voice key triggered the images and verb to disappear once the participant responded into the microphone. Participants were given 5000 ms to complete the sentence. Filler trials were identical to experimental trials except only pictures representing the agent noun were included in the filler trials.

4.3.4 Post-test

After testing participants were tested with four fill in the blank questions to ensure the participants knew the difference between the English and Spanish possessive pronoun gender agreement rules. All participants answered the gender agreement questions correctly.

1. Ella es la hermana del pirata. El pirata dice que la hermana es ____.
2. Él es el hermano de la bailarina. La bailarina dice que el hermano es ____.
3. Ella es la madre de la enfermera. La enfermera dice que la madre es ____.
4. Él es el padre del médico. La enfermera dice que el padre es ____.

4.3.5 Coding

Responses were coded according to the gender agreement rules used in the participants responses. Responses using the gender agreement consistent with the target language were coded as 0. Responses using the gender agreement inconsistent with the target language were coded as 1. Examples of inconsistent responses are as follows:

The pirate thinks the sister is *hers*.

La enfermera dice que el hermano es *suya*.

The boxer doubts the daughter es *suyo*.

La camarera espera que el tío is *his*.

All other responses were coded as NA, including failure to respond in the correct target language, responding without a possessive pronoun, and the failure to respond.

4.4 Results

The vast majority of participant responses were consistent with the gender agreement of the target language. As expected, there were a higher number of inconsistent gender agreement responses (17) when switching from English as the source language into Spanish as the target language. This was higher than the number of incongruent responses (9) when switching from Spanish as the source language into English as the target language (See Table 2).

Table 2.

Results						
Conditions				Responses		
Gender matching	Source Language	Target Language	Language Condition	Consistent gender agreement	Inconsistent gender agreement	NA
Matching	English	English	One-Language	154	0	6
Mismatch	English	English	One-Language	153	0	7
Matching	Spanish	Spanish	One-Language	149	2	9
Mismatch	Spanish	Spanish	One-Language	142	6	12
Matching	English	Spanish	Two-Language	146	1	13
Mismatch	English	Spanish	Two-Language	124	17	19
Matching	Spanish	English	Two-Language	144	2	14
Mismatch	Spanish	English	Two-Language	134	9	17

The dependent variable of congruent or incongruent gender responses were coded as binomials (consistent = 0, inconsistent =1). Responses were modelled using logit mixed effects models (Jaeger, 2008) by using the glmer function with the lme4 package version 1.1.12 (Bates, Maechler, Bolker, & Walker, 2015). Every model reported for Experiment 4.1 attempted a maximum random effects structure of intercept and slope of participants and items (Barr, Levy, Scheepers, & Tily, 2013). All models tested for Experiment 4.1 failed to converge with the maximum random effects structure. Random effect structure was then simplified until models converged. The models only converged using the minimum random effects structure of by participant and by item random intercepts.

The first model I tested was the three way interaction of source language (English vs Spanish), target language (English vs Spanish) and gender matching (matching vs mismatch). Running this model under the minimum random effects structure failed to converge. It is assumed that the failure to converge is due to the large number of consistent gender agreement responses in comparison to the very few inconsistent gender agreement responses. Because there are very few inconsistent responses in the one-language condition, I removed this condition from further analysis. Because the combination of source language and target language conditions only yield two different variables, the source language and target language conditions were merged to create the switch variable (English to Spanish vs Spanish to English). Using the data set for the two-language condition and the new switch variable, I tested a new model with the interaction between switch and gender matching as predictors. The model revealed a significant main effect of gender matching but no interaction effect. Using a log-likelihood ratio χ^2 test, the model with the interaction of switch and gender as predictors was a better fit for the data set than the null model (see Table 3).

Table 3.

Predictor	Estimate	Standard Error	z value	p
Model with interaction of switch and gender matching as predictor: $\chi^2(3) = 16.782, p < .001, N = 577$				
(Intercept)	-5.137	1.045	-4.907	<.001
Gender: mismatch	3.032	1.075	2.820	0.005
Switch: Spanish to English	0.719	1.262	0.570	0.569
Gender: mismatch x Switch: Spanish to English	-1.458	1.364	-1.069	0.285

Modelled using data set from the two-language condition

This means that there were significantly more incongruent responses in the gender mismatch condition than in the gender match conditions. There was no indication as to whether mismatching gender had a greater effect when switching from English to Spanish or when switching from Spanish to English.

Looking at the raw data in Table 2 there were more incongruent agreement responses when Spanish, the participants' L2, was the target language than when English, the L1, was the target language. In fact, the only incongruent responses in the one-language condition were in Spanish. Because these incongruent responses were infrequent, this effect does not appear to be due to a lack of knowledge regarding the different agreement rules in Spanish. However, it is possible that the

L2 did play a role in this effect. In order to determine whether L2 played a role in the results, I ran an additional model on the two-language condition with target language as main effect. This model did not show a significant effect of target language ($p < .055$).

4.5 Discussion

In the two-language condition, participants made the majority of incongruent gender agreement responses in the mismatch gender condition, and there was no significant difference in whether participants switched from English to Spanish or from Spanish to English. These results are consistent with the predictions of the Hybrid model. The Hybrid model predicted that inconsistent gender agreement responses are likely to occur in the mismatch gender condition when the gender agreement rules from both source and target languages compete for selection at the word-form level. In other words, the Hybrid model predicted that gender matching is the predictor that leads to the largest effect and this effect should occur regardless of the source or the target language. This was the pattern observed in the data analysis.

The MLF model makes the same prediction but for a different reason. The MLF model predicted that in the two-language condition speakers will make incongruent gender agreement responses in the mismatch gender condition because the agreement rules of possessive pronouns in English and Spanish makes the possessive pronouns late system morphemes. As discussed above, the experimental materials were manipulated so that the source language became the ML of the utterance. According to the MLF model, as the ML, the source language became the only language that could provide late system morphemes. The results revealed that participants made more incongruent responses in the mismatch gender condition. Recall that the participants were instructed to switch languages before the final NP. Participants did not switch between the possessive pronoun and the final noun because they were instructed not to. Because of this, the experiment was unable to truly test the MLF. However, the experiment did test whether the agreement features would be available from the source language when speaking in the target language when they required information from outside of their maximal projection. The results

showed that the agreement features for both languages were available when switching languages.

Finally, the effect of target language on incongruent responses was not significant. That is, incongruent responses were no more likely to occur in the participants' L2 than in their L1; however, it should be noted that the effect was trending towards significance ($p = .055$). Neither the Hybrid model nor the MLF model make any strong predictions in regards to differences in L1 and L2 competencies.

Experiment 4.2

Spanish-English code-switching of possessive pronouns

4.6 Rationale and predictions

In Experiment 4.2 I tested Spanish-English bilinguals in the same experimental paradigm. I expected to find the same overall pattern as in Experiment 4.1.

4.7 Method

4.7.1 Participants

Twenty native Spanish speakers (10 female, 10 male) were recruited from the George Square campus of the University of Edinburgh. The results from five additional participants were discarded due to a large number of other responses. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of English in order to participate. The participants had a mean age of 22.9 years ($SD = 1.79$) and reported having an average of 9.2 years of English language experience. Prior to running the experiment, participants were given a self-rated proficiency questionnaire for their English production, reading, and writing skills. On a five point scale, the participants averaged 4.35 in production, 4.15 in reading, and 4.10 in writing skills for an overall average proficiency score of 4.20. Participants were also given a language demographic questionnaire. Of the 20 participants 13 speak or are learning to speak a language in addition to Spanish and English. Fifteen participants speak Spanish as their main language at home and five

speak English as their main language at home. Finally, 17 of the 20 participants reported speaking English regularly at home. The participants spent an average of 3.3 years ($SD = 1.31$) in an English speaking county prior to testing. Participants received six British Pounds for their participation in the study.

4.7.2 Stimuli materials

The materials were the same as for Experiment 4.1.

4.7.3 Procedure

The procedure was the same as for Experiment 4.1.

4.7.4 Post-test

After testing participants were given four fill in the blank questions to ensure they knew the difference between the Spanish and English possessive pronoun gender agreement rules. All participants answered the gender agreement questions correctly.

1. She is the pirate's sister. The pirate says the sister is ____.
2. He is the ballerina's brother. The ballerina says the brother is ____.
3. She is the nurse's mother. The nurse says the mother is ____.
4. He is the doctor's father. The nurse says the father is ____.

4.7.5 Coding

Responses were coded the same way as for Experiment 4.1.

4.8 Results

As with the results of Experiment 4.1, the majority of responses were consistent with the gender agreement of the target language. Unlike the native English participants, apart from one inconsistent gender agreement response in the one-language condition, the remaining inconsistent responses were in the two-language condition (see Table 4).

Data analysis for Experiment 4.2 is conducted in the same manner as for Experiment 4.1. Every model reported for Experiment 4.2 attempted a maximum random effects structure of intercept and slope of participants and items. All models

tested for Experiment 4.2 failed to converge with the maximum random effects structure. Random effect structure was then simplified until the models converged. The models only converged using the minimum random effects structure of by participant and by item random intercepts.

Table 4.

Results						
Conditions				Responses		
Gender matching	Source Language	Target Language	Language Condition	Consistent gender agreement	Inconsistent gender agreement	NA
Matching	English	English	One-Language	154	0	6
Mismatch	English	English	One-Language	153	1	6
Matching	Spanish	Spanish	One-Language	143	0	17
Mismatch	Spanish	Spanish	One-Language	142	0	18
Matching	English	Spanish	Two-Language	138	2	20
Mismatch	English	Spanish	Two-Language	129	7	26
Matching	Spanish	English	Two-Language	149	2	9
Mismatch	Spanish	English	Two-Language	139	12	11

I first tested the three way interaction of source language (English vs Spanish), target language (Spanish vs English), and gender matching (matching vs mismatching). Like in Experiment 4.1 this model failed to converge, likely because of the large number of congruent responses compared to incongruent responses. Again I removed the one-language condition from the further data analysis in order to test the interaction. Like in Experiment 4.1 I merged the source language and target language conditions to create the switch variable (English to Spanish vs Spanish to English). Using the data set for the two-language condition and the new switch variable, I tested a new model with the interaction between switch and gender matching as predictors. The model with the interaction of switch and gender matching did not show any significant effects. I tested another model using only gender matching as main effect. In this model the main effect of gender matching was significant ($p = 0.015$). Using a log-likelihood ratio χ^2 test, I compared the model with gender matching as main effect against the null model. The model with gender matching as main effect was revealed to be a better fit of the data (see Table 5). This means that there were significantly more inconsistent responses in the mismatch gender condition than in the match gender condition.

Table 5.

Predictor	Estimate	Standard Error	z value	p
Model with gender matching as predictor: $\chi^2(1) = 6.361, p = .012, N = 574$				
(Intercept)	-4.275	0.559	-7.649	<.001
Gender: mismatch	1.390	0.570	2.441	0.015
Modelled using data set from the two-language condition				

4.9 Discussion

Experiment 4.2 revealed that in the two-language condition participants made the majority of incongruent gender agreement responses in the mismatch gender condition. In the next section I report data analyses using the combined data from Experiments 4.1 and 4.2.

4.10 Combined analysis

Experiment 4.1 and Experiment 4.2 were both conducted using the same stimulus materials, the only difference was that Experiment 4.1 tested native English speakers and Experiment 4.2 tested native Spanish speakers. Because both experiments tested the same materials, I conducted a combined analysis on the data. The combined data analysis was conducted in the same manner as Experiments 4.1 and 4.2. Every model reported in the combined analysis attempted a maximum random effects structure of intercept and slope of participants and items. All models tested for the combined analysis failed to converge with the maximum random effects structure. Random effect structure was then simplified until models converged. The models only converged using the minimum random effects structure of by participant and by item random intercepts.

On the full data set the first model I tested was the three way interaction of source language (English vs Spanish), target language (English vs Spanish), and gender matching (match vs mismatch). Like the other attempts of testing the three way interaction, this model failed to converge. The one-language condition was then removed from the remaining data analysis. Like in Experiments 4.1 and 4.2, I merged the source language and target language conditions to create the switch variable (English to Spanish vs Spanish to English). Using the data from the two-language condition, I tested a new model with the interaction between switch and gender matching as predictors. The model revealed a significant main effect of

gender matching ($p = .002$) but did not reveal any interaction effect. Using a log-likelihood ratio χ^2 test, the model with the interaction of switch and gender as predictors was a better fit for the data set than the null model (see Table 6).

Table 6.

Predictor	Estimate	Standard Error	z value	p
Model with interaction of switch and gender matching as predictor: $\chi^2(3) = 16.905, p < .001, N = 1151$				
(Intercept)	-4.672	0.623	-7.505	<.001
Gender: mismatch	2.118	0.684	3.098	0.002
Switch: Spanish to English	0.247	0.820	0.302	0.763
Gender: mismatch x Switch: Spanish to English	-0.471	0.926	-0.508	0.611

Modelled using data from Experiment 4.1 and Experiment 4.2 from the two-language condition

This means that there were more incongruent responses in the gender mismatch condition than in the gender match condition, and there were no differences in this effect when participants switched from English to Spanish or from Spanish to English.

As an additional analysis I tested to see whether there were any differences between participant groups. I tested a model using native language (English vs Spanish) as a predictor. The results revealed no significant effect of native language. This means that both native English speakers and native Spanish speakers made an equal number of incongruent responses during the experiment.

4.11 General discussion

The results of both experiments showed that participants were more likely to produce incongruent gender agreement responses in the mismatch gender condition. In either native language group, the effect of gender mismatch did not show any difference whether participants switched from English to Spanish or from Spanish to English. These results are consistent with the predictions of the Hybrid model. The results can be explained by the Hybrid model's mechanism for possessive pronoun selection. The Hybrid model assumes that possessive pronoun selection occurs at the word-form level. Like the nouns they represent, possessive pronouns are located at the lemma level. During monolingual production, the gender feature node of the controller noun activates the gender feature node of the possessive pronoun which leads to activation of appropriate word-form for selection.

During bilingual language production if the two languages have different agreement rules, like English and Spanish, selection of the possessive pronoun word-form becomes more complicated. If the two controller nouns are the same gender, like the example “*the ballerina says the sister...*”, then only the feminine gender node of the possessive pronoun becomes activated. This leads to activation of the two feminine word-forms, *suya* and *hers*. The language node also sends activation to the word-form of the language the speaker intends to speak, making it so the word-form of the target language is more likely to be selected. If the two controller nouns are of different genders, like the example “*the pirate says the sister...*” then the gender feature nodes of *pirate* and *sister* lead to activation of both gender feature nodes of the possessive pronoun. Because both gender feature nodes of the possessive pronouns are activated, all four word-forms become activated: the masculine *suyo* and *his*, and the feminine, *suya* and *hers*. The language node of the target language sends a higher level of activation to the word-forms of the target language so participants are more likely to use the correct language as the target language.

Let us consider how congruent and incongruent responses will occur with the example utterance “*the pirate says the sister...*” in which participants are asked to complete the sentence in Spanish. The controller nouns for English and Spanish are of different genders, *pirate* for English and *sister* for Spanish. The *pirate* lemma activates the masculine gender feature node which activates the masculine feature node of the possessive pronoun lemma. The *sister* lemma activates the feminine gender feature node which activates the feminine feature node of the possessive pronoun lemma. Both gender feature nodes of the possessive pronoun lemma are activated, and this activation is cascaded down to the word-form level. All four possessive pronoun word-forms are then activated, *his* and *hers* in English, and *suyo* and *suya* in Spanish. Because Spanish is the target language, the Spanish word-forms receive heightened activation via the Spanish language node. Congruent gender agreement responses occur when the feminine feature node receives the highest level of activation, leading to the selection of the form *suya*. Incongruent gender agreement responses occur when the masculine feature node receives the highest

level of activation, leading to the selection of the incongruent form *suyo* (see Figure 6).

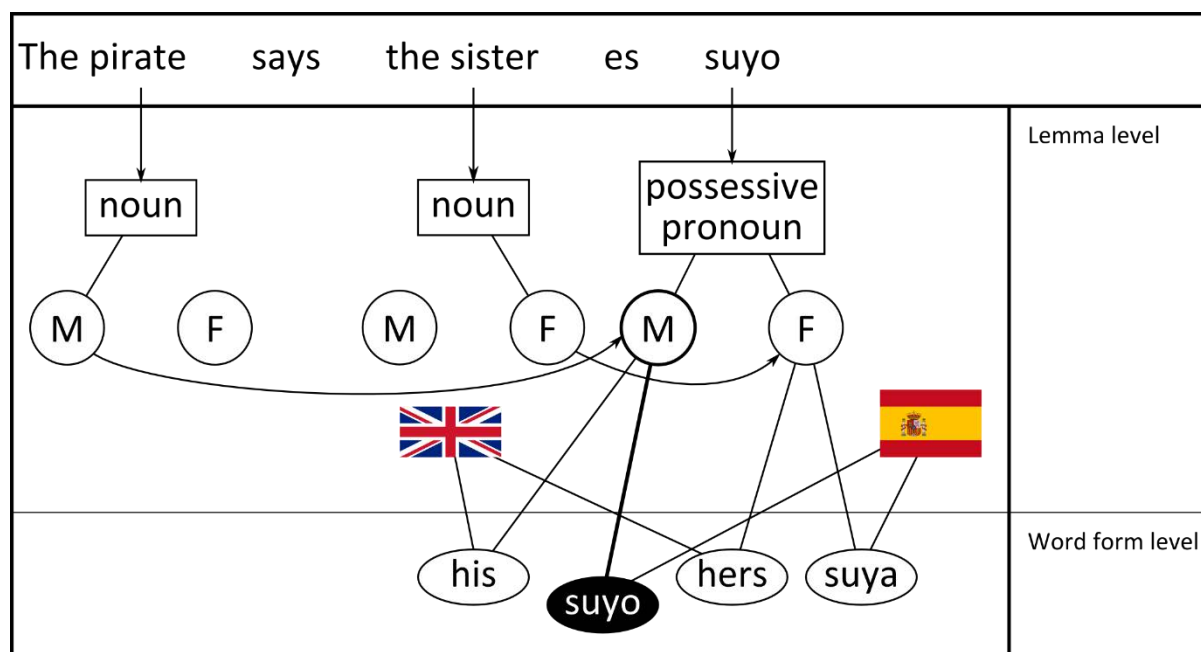


Figure 6. Production of an incongruent gender agreement response from Experiment 4.1. The top line represents the completion of the experimental sentence. The English and Spanish lemmas representing *pirate* and *sister* are omitted for simplicity. The lines represent connections between nodes. The arrows represent the direction of spreading activation. The labels M and F refers to the masculine and feminine gender feature nodes respectively. The filled black oval represents the selection of the possessive pronoun.

Antón-Méndez (2011) found a similar pattern of results in an experiment that elicited English possessive determiners. In the experiment participants saw the picture of a person or a group of people in the top left corner of the screen and were then presented with a written sentence. Participants were told that the sentence is coming from the person or people in the picture, and their task was to retell the sentence. The retelling of the presented sentence was intended to elicit possessive determiners, for example the presented, “*My father gets a new position in another department*” was to be retold as “*His/her father gets a new position in another department*” (Antón-Méndez, 2011). The gender of the person in the picture and the gender of the person the sentence was about were either the same gender, or different genders. Participants in the experiment were native speakers of Dutch, Spanish, and Italian. The gender agreement rules for Italian possessive determiners differ from those of English. Gender agreement of Italian possessive determiners is like Spanish,

they agree in gender with the possessed noun whereas in English the possessive determiner agrees in gender with the possessor noun. In Spanish, the third person singular possessive determiner is not marked for gender. The Dutch speakers were used as a control group because gender agreement of Dutch possessive determiners follows the same rules as English. The results showed that Italian and Spanish speakers produced more gender agreement errors than the Dutch speakers, and that the majority of the errors were in the mismatched gender condition. This pattern of results is consistent with the results of my experiments summarised in this chapter. Italian speakers made gender agreement errors in English in a way that matched their L1 gender agreement rules. Interestingly, even though third person possessive pronouns do not have gender marking in Spanish, the Spanish speakers made the same pattern of errors as Italian speakers. This may be due to the fact that other gender agreement rules in Spanish follow the same principles as in Italian. However, in order for this interpretation to be correct, we must then assume that Spanish speakers still retrieve gender information from the possessed noun even for instances in which their utterance does not require gender marking.

The results also showed that there were incongruent gender agreement responses in the one-language condition but this effect was not significant. Nevertheless, the lemma stratum of the Hybrid model can account for how incongruent responses can occur in the one-language condition. The Hybrid model accounts for residual activation of the possessive pronoun feature nodes that occurs from trial to trial. If a one-language trial follows a trial in which the other language was active (e.g., Spanish-Spanish trial follows after a Spanish-English trial), residual activation from the other language can have an effect on the response of the one-language trial. If the previous trial was a two-language condition trial, then both languages become activated. The activation from both languages does not disappear immediately, the activation lingers and this is referred to as residual activation. It is possible that this residual activation is high enough to elicit an incongruent gender agreement responses in the one-language trial.

In support of the view that residual activation can affect responses in trials that only require one language, Hatzidaki et al., (2011) found that English-Greek and Greek-English speakers were sensitive to the syntactic features of nouns whose

translation equivalent was mismatch in number agreement. In this study participants performed a sentence completion task in which they were presented with a critical noun and were asked to complete a sentence using the critical noun. The critical noun was singular in one language and plural in the other language. Participants either produced sentences in one language (one-language trial) or were required to code-switch after the critical noun (code-switched trial). In code-switched trials participants showed a tendency to produce verbs that agreed in number with the critical noun that was produced in the other language. In other words, participants produced the target language verb which agreed in number with the source language noun. The authors argued that when switching languages, the syntactic features of source language remained activated, influencing the verb agreement of the target language. Interestingly, this effect also occurred in one-language trials, trials in which participants were not required to code-switch. The authors argued that in the one-language trials there was residual activation at the syntactic level from when the other language was last used. This residual activation from the language not in use influenced verb agreement responses that agreed in number with the translation equivalent of the verb presented.

In Experiment 4.1 with this group of participants the raw data showed that native English speakers made more incongruent responses when the target language was Spanish than when the target language was English. Though this effect was not significant, it was marginal ($p = .055$). Let us consider the possibility that this trend was an effect of the English speakers' L2. It is possible that low proficiency bilinguals send more activation through the gender feature node of the controller noun of the L1 in comparison to the controller noun of the L2. If we compare the self-ratings of proficiency between the native English group and the native Spanish group, the native English group has a lower overall proficiency score in Spanish (3.95) than the native Spanish speakers' proficiency score in English (4.20). If there is a L2 effect it may be tied to proficiency. In other words, the L2 effect may be strongest when speakers are not very proficient in their second language. This proposal may also be explained by the results reported from Antón-Méndez (2011). In the Antón-Méndez study, both Italian and Spanish speakers made incongruent gender agreement responses in English that followed the agreement rules of their

native language. It is possible that in the sentences that elicited the agreement errors, the possessed noun sent a higher level of activation through the gender feature node than possessor noun. In the mismatched gender condition this would lead to an incongruent gender agreement response in English.

The Hybrid model accounts for the current set of data assuming a syntactic source for agreement. How does the Hybrid model account for the research that shows agreement is sensitive to conceptual features as well as syntactic features? Though not explicitly tested, it is possible that featural nodes at the lemma level are also activated through conceptual features at the conceptual level. For example, collective nouns that are grammatically singular may activate both singular and plural feature nodes of the noun lemma. The grammatical number feature is activated by the lemma at the lemma level but the conceptual number feature is activated from the conceptual level. Distance effects demonstrate that pronouns tend to agree syntactically at short distances from the controller noun but agree conceptually at larger distances from the controller noun (Garnham et al., 1995; Meyer & Bock, 1999; Schweppe, 2013). Returning to a previous example, the German noun for girl, '*Mädchen*', is grammatically neuter but conceptually feminine. Over short distances speakers may refer to '*Mädchen*' with a neuter pronoun which agrees syntactically, but as the distance becomes longer they may use a feminine pronoun which agrees conceptually. It is possible that these distance effects are due to a higher initial activation level for grammatical features, but the activation dissipates quicker for grammatical features than for conceptual features. In other words, grammatical feature will receive a higher level of activation, but over time the conceptual feature maintains its activation for longer. The same principle may also contribute to attraction; grammatically plural local nouns contribute to attraction whereas conceptually plural nouns do not (Bock et al., 2004; Eberhard et al., 2005). This may be a manifestation of distance effects; a shorter distance between the local noun and the pronoun makes grammatical features more likely to be selected than the conceptual features. However, this potential distance effect on attraction does not explain why pronouns show attraction to plural local nouns rather than singular local nouns.

The MLF model made different theoretical predictions than the Hybrid model, but the expected results are the same. The 4-M model states that the possessive pronouns are late system morphemes, and the MLF model states that late system morphemes can only come from the ML. As noted earlier, the experimental items were manipulated so that participants were forced to switch languages before the possessive pronoun. Because participants were not given the option to switch languages after the possessive pronoun or at a point of their choosing, the experiment may not have been suitable to test the MLF predictions. It is possible that during natural code-switching speakers would avoid switching at this point of the utterance. Speakers may prefer to produce the possessive determiner in ML rather than the EL as the experiment forced them to do.

4.12 Chapter summary

In this chapter I reported two experiments that investigated the ways in which speakers produce possessive pronouns that differ in gender agreement rules during code-switching. I summarised the predictions of the proposed Hybrid model as well as the predictions of the MLF model. The results from both experiments revealed that incongruent gender agreement responses occurred more often in the mismatch gender condition than the gender match condition. The mismatch gender effect occurred equally when switching from English to Spanish and from Spanish to English. These results support the mechanism of possessive pronoun selection as described by Hybrid model. In Experiment 4.1 there were a few incongruent responses in the one-language condition. I proposed that this could be due to residual activation from previous trials that lead to the erroneous selection of the incongruent gender agreement. I also proposed that a potential L2 effect from the native English speakers could manifest in a mechanism that by default sends a higher amount of activation through the noun that controls the L1 gender agreement of possessive pronouns. This effect decreases as the speaker becomes highly proficient in their L2. The results of the experiments also support the predictions of the MLF model but it is possible that the experimental task was not suitable to properly test the MLF model.

Chapter 5

An investigation of gender agreement rules for French and English possessive determiners

5.0 Chapter overview

The previous chapter investigated the production of possessive pronoun agreement in code-switching between English and Spanish. I tested the predictions of the Hybrid model that states, during code-switching, possessive pronouns can be produced in one language while following the agreement rules of the other language. The current chapter investigates the same prediction from the Hybrid model that during code-switching, possessive determiners can be produced in one language while following the agreement rules of the other language. As an additional manipulation, the current chapter investigates the difference in processing between agreement rules that follow the 4-M definition of an outsider system morpheme, and agreement rules that follow the 4-M definition of an early system morpheme. Possessive determiners in English receive agreement information from outside of their NP making them outsider system morphemes. Possessive determiners in French receive agreement information from within their NP, making them early system morphemes. According to the MLF, outsider system morphemes can only come from the ML whereas early system morphemes can come from either ML or EL. The purpose of this chapter is to summarise and test the predictions put forth by the Hybrid model and the MLF model.

5.1 Theoretical grounds

In order for a model of language production to be comprehensive it must be able to account for the selection and production of all types of words. The nature of open-class word production has been the interest of production models (Levelt et al., 1999; Pickering & Branigan, 1998). However, very few production models attempt to account for the production of closed-class words (Garrett, 1990; Myers-Scotton, 1993, 1997, 2002; Myers-Scotton & Jake, 2016). One weakness of the Hartsuiker and Pickering (2008) model is that the model emphasises production of verbs and nouns, but is underspecified in explaining the ways in which closed-class morphemes are produced. The architecture of the lemma stratum outlined by the model is only

explained by verb and noun production; the production of determiners and other function words are largely ignored. In order to gain insight into closed-class word production we turn to the study of determiner selection.

Following from the previous chapter on possessive pronouns, the current chapter aims to further test the Hybrid model on the production of closed-class items. The current chapter investigates the production of possessive determiners. It is generally agreed that determiner selection is through a process of indirect election, that the selection of the correct determiner depends on the syntactic information of the head noun (Garrett, 1990; Levelt, 1989; Myers-Scotton & Jake, 2000a; Schriefers et al., 2002). Studies suggest that the level of competition for determiner selection is at the level of the determiner form (Schiller & Caramazza, 2003; Schriefers et al., 2002). Recent literature on determiner selection supports the view that determiner selection is a competitive and cascaded process (Dhooge, De Baene, & Hartsuiker, 2016; Jescheniak, Schriefers, & Lemhöfer, 2012, 2014; but see Janssen, Schiller, & Alario, 2014).

The Hartsuiker and Pickering (2008) model makes no claims regarding the access of determiners or possessive determiners. However, the Hybrid model takes the architecture of the lemma stratum for content morphemes, and assumes determiner selection follows the same selection by competition as content morphemes as evidenced by the studies on determiner selection reviewed above. In the Hybrid model and other models of determiner selection, in NPs determiners are indirectly elected by the head noun of the phrase. The Hybrid model assumes featural nodes of the head noun, such as gender and number, activate the appropriate determiners for selection. Research on determiner selection shows that competition for selection is not at the syntactic level, but at the form level. Recall that the Hybrid model is a cascaded model and assumes that syntactic nodes activated at the lemma level cascade down to the word-form level to activate the word-forms. For languages with gendered determiners it is assumed that the activated gender feature nodes at the lemma level sends activation down to the word-form level. Using the French example given earlier, the French noun *chat* is masculine and therefore activates the masculine featural node. The masculine featural node then activates the phonological form of the masculine determiner *le*, which then competes for selection with the

feminine determiner *la*. The form with the most activation will be selected. In our example, the masculine determiner *le* will be selected.

Another account of closed-class production is the MLF model. The MLF model accounts the production of closed-class items by using the morpheme distinctions described by the 4-M model (Myers-Scotton, 2002; Myers-Scotton & Jake, 2000a, 2000b). We first turn to the 4-M model. The 4-M model is a model that breaks morpheme types into four categories depending on their role during language production. The four morpheme distinction was detailed in Chapter 2. For the purpose of the current experiment I will briefly discuss early and outsider system morphemes. Early system morphemes are indirectly elected by the content morpheme that heads their constituency. For example, for languages with grammatical gender, determiner form is dependent on gender and number features of the head noun, and in English the plural suffix morpheme *s* is dependent on the number feature of its head noun. Outsider system morphemes are morphemes that require information from outside of their head constituency for information on their form. Examples of outsider system morphemes are verb agreement marking, because the verb requires the subject NP for person and number information, and case-marking which requires larger linguistic units to form in order to receive grammatical function assignment for case information (Myers-Scotton, 2002). Recall, the MLF model is a production model that describes the ways in which these four types of morphemes are used during code-switching. Outsider system morphemes can only come from the ML, the language that provides the syntactic structure for the utterance. All other morpheme types can come from either ML or EL (Myers-Scotton, 2002).

The current chapter involves two experiments that investigate the production of possessive determiners in English and French. According to the 4-M model, in general determiners are early system morphemes because they depend on their head noun for information regarding their form (Myers-Scotton, 1997; Myers-Scotton & Jake, 2000a, 2000b). The head noun indirectly elects the appropriate determiner depending on the syntactic features for the target noun. In English, determiners are limited in their form. In French, determiners vary depending on grammatical gender and number of the noun. For example, the noun *chat* is masculine singular, so during

production it will indirectly elect the masculine singular determiner *le*. The Hybrid model assumes that the selection of French possessive determiners follow the same rules as French determiners because in French possessive determiners agree in gender with the possessed noun which heads the NP. In other words, the French possessive determiner lemma receives activation of its featural nodes from the featural nodes of the possessed noun. In English the possessive determiner agrees in gender with the possessor noun. The Hybrid model assumes that English possessive determiner lemma receives activation of its featural nodes from the featural nodes of the possessor noun. To word this differently, agreement features of possessive determiners comes via activation of the featural nodes of the controller noun, whether the controller noun is the possessor or the possessed noun.

Experiment 5.1

English-French code-switching of possessive determiners

5.2 Rationale

The current experiment is a bilingual sentence completion task in English and French in which participants are forced to code-switch before a noun phrase indicating possession with a possessive determiner. Experimental trials are transitive sentences with a possessive determiner appearing in the object NP. Participants listened to a subordinate clause in either French or English and were visually presented with a verb in the same language as the subordinate clause. Upon repeating the subordinate clause they were shown two characters; one character played the role of the agent and the other played the role of the patient of the sentence. For half of the trials participants responded entirely in one language, and for half of the trials participants had to switch languages for the final NP. As with the previous experiments, I refer to the initial language participants use as the source language, and the language in which the participants are asked to produce the final NP as the target language. The target language is manipulated by providing a language cue on the picture of the object NP. As a further manipulation, in half of the trials the gender of the subject and object nouns was the same; we call this the gender match condition. In the other half of the trials the gender of the subject and the object nouns will be different; we call this the gender mismatch condition. By eliciting participants to code-switch before producing a possessive determiner in the mismatch gender

condition, we can identify whether speakers demonstrate a preference between agreeing in gender with the possessor, following the English gender agreement rules, or with the noun that is being possessed, following the French gender agreement rules.

5.2.1 Predictions

The Hybrid model predicts that instances of inconsistent gender agreement will be dependent on gender matching, specifically that there will be more inconsistent gender agreement responses in the gender mismatch condition. During code-switching, the effect is expected to occur both ways: speakers will sometimes use the French gender agreement when the target language is English, and sometimes use the English gender agreement when the target language is French. The Hybrid model predicts that there will be no significant difference in incongruent gender agreement responses when switching from English to French or from French to English. This prediction is due to the activation of the gender feature nodes of the possessive determiner from the gender features nodes of the controller nouns from both languages. Because both languages have different controller nouns, the mismatch gender condition will have both gender nodes of the possessive determiner activated. The competition for selection mechanism is such that the controller features from one language may be selected even if the output is in the other language. In the current experiments it is assumed that participants will select the target language as the output language. The controller features selected may depend on other factors such as, frequency of occurrence, native language, and second language proficiency.

The MLF model makes the prediction that there will be a tendency to use more French possessive determiners in the switching trials when switching from English to French and from French to English. The controller noun for the agreement of French possessive determiners is within the same NP as the possessive determiner. As defined by the 4-M model, this makes French possessive determiners early system morphemes. The controller noun for English possessive determiners falls outside of the NP of the possessive determiner (see Figure 7). As defined by the 4-M model, this makes English possessive determiners outsider system morphemes. According to the MLF model, outside system morphemes can only come from the

ML, but early system morphemes can come from either the ML or the EL. If French is the ML and speakers switch to English before producing a NP with a possessive determiner, speakers should be less likely to use English gender agreement because it is an outsider system morpheme, and they should be more likely to use the French gender agreement for the possessive determiner because it is an early system morpheme. Conversely, when code-switching from English as the ML to French as the EL, speakers should be able to use either English or French gender agreement rules. In other words, for the experimental tasks that require code-switching the MLF model predicts that speakers will use the French gender agreement more often than the English gender agreement.

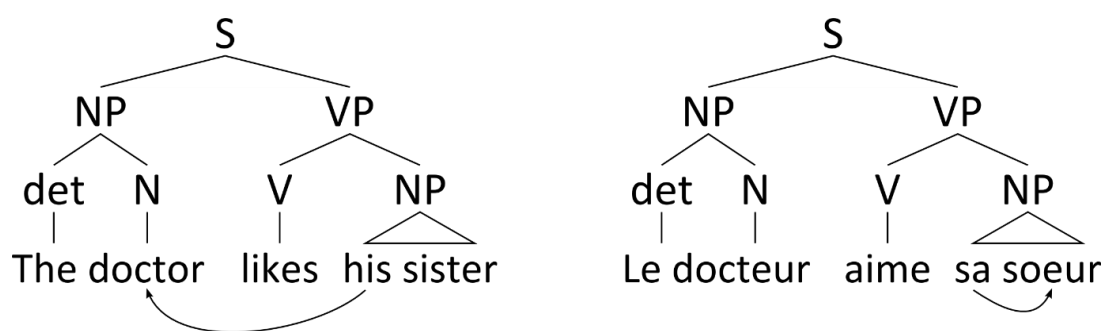


Figure 7.

5.3 Method

5.3.1 Participants

Thirty-two native English speakers (20 female, 12 male) were recruited from the George Square campus of the University of Edinburgh. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of French in order to participate. The participants had a mean age of 21.5 years (SD = 2.36) and reported having 7.8 years of French language experience. Prior to running the experiment, participants were given a self-rated proficiency questionnaire for their French production, reading, and writing skills. On a five point scale, the participants averaged 4.44 in production, 4.13 in reading, and 4.06 in writing skills for an overall average proficiency score of 4.21. Participants were also given a language demographic questionnaire. Of the 32 participants 15 speak or are learning to speak a language in addition to English and French. Twenty-one

participants reported living in a French speaking country. All 32 participants speak English as their main language at home. Finally, seven of the 32 participants reported speaking French at home. Participants received six British Pounds and fifty pence for their participation in this study.

5.3.2 Stimuli materials

Conditions			
Gender matching	Source Language	Target Language	Example
Match	English	English	At the station, the doctor likes... his brother.
Mismatch	English	English	At the station, the doctor likes... his sister.
Match	French	French	À la gare, le docteur aime... son frère.
Mismatch	French	French	À la gare, le docteur aime... sa soeur.
Match	English	French	At the station, the doctor likes... son frère.
Mismatch	English	French	At the station, the doctor likes... sa soeur.
Match	French	English	À la gare, le docteur aime... his brother.
Mismatch	French	English	À la gare, le docteur aime... his sister.

The experimental items were created by combining an aurally presented sentence preamble with a visually presented verb in its infinitive form, a picture of a character representing the subject of the sentence and a picture of a character representing the final object NP to induce a complete sentence. Thirty-two sentence preambles indicated a time or place (e.g., *In the morning.../At the train station...*) and were translated from English to French to give a total of 64 sentence preambles. A male English speaker recorded the English preambles, and a male French speaker recorded the French preambles. Twenty-four infinitive verbs were selected to express the action of the sentence and were translated from English to French to give a total of 48 verbs. Pictures of 8 characters (4 female, 4 male) were selected to act as the subject of the sentence, and 8 family members (4 female, 4 male) were selected to act as the direct object of the sentence. The pictures of the characters and family members are paired to make matching gender pairings (female-female, male-male) and mismatching gender pairings (female-male, male-female). The pictures of the family members were presented within either a circular border or a square border to act as a language cue; the square border indicated participants were to complete the sentence with the same language, and the circular border indicated participants were to switch languages (see Appendix C).

Sentence preambles, verbs and the pictures of the characters and family members were combined and manipulated to make four language versions: an English-English version, a French-French version, a French-English version, and an English-French version. The English-English version set consisted of English preambles, English verbs, pictures of the characters, and pictures of the family members within a square border. The French-French version consisted of French preambles, French verbs, pictures of the characters, and pictures of the family members within a square border. The French-English version consisted of French preambles, French verbs, pictures of the characters and pictures of the family members within a circular border. The English-French version consisted of English preambles, English verbs, pictures of the characters and pictures of the family members within a circular border (see Figure 8 for examples of stimuli and procedure). The experiment used a Latin square design; 4 lists were created using 16 unique items from each language version so that no preamble, verb, character, and family member combination was repeated, making a total of 64 experimental items per list. Filler items were created using an identical format as experimental items with the exception of using 30 different verbs and eight inanimate objects as the direct object of the sentence. Similar to the family members, the pictures of inanimate objects presented within a square or circular border. There was a total of 128 filler items.

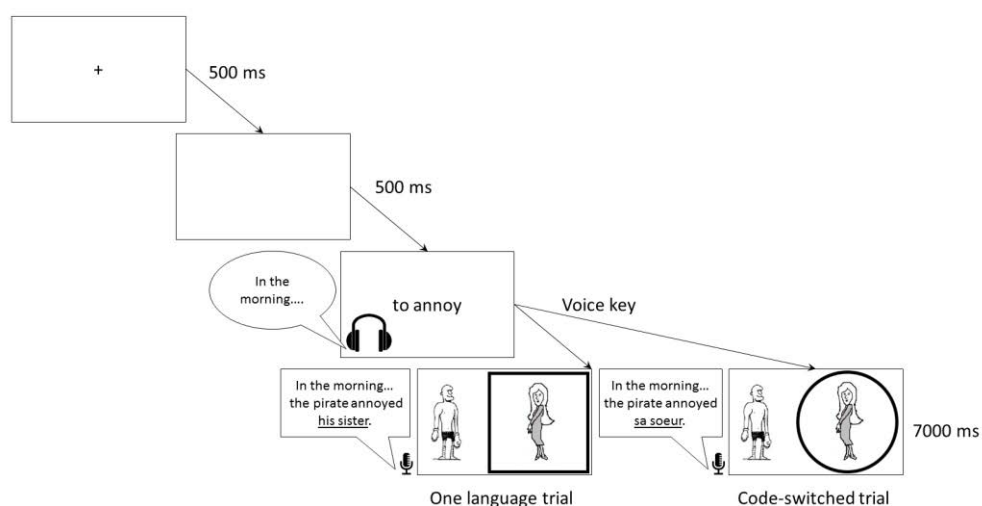


Figure 8.

5.3.3 Procedure

Prior to testing, participants filled out a demographic questionnaire including a self-evaluation of their French proficiency. Instructions were presented entirely in English. The experiment was a sentence completion task in which participants listened to a sentence fragment, were asked to repeat the fragment and complete the sentence by using the picture that appeared on the screen. Each trial began with a fixation point that was presented for 500 milliseconds followed by a blank screen for 500 milliseconds. Participants were then presented a spoken sentence fragment in their headphones and a written verb in its infinitive form was presented on the computer screen. As soon as the participant spoke into the microphone, the voice key triggered the pictures of the character and family to display on the screen. The character always appeared on the left to indicate it was the subject of the sentence, and the family member appeared on the right side of the screen to indicate it was the direct object of the sentence. Participants were instructed to start the utterance in the same language as the preamble, and to complete the sentence in the same language if the object character was surrounded by a square border, and to switch languages if the family member was surrounded by a circular border. Participants were instructed that in the two-language condition they had to switch languages when naming the family member. Participants were given 7000 ms to complete their response before the next trial began. Filler trials were identical to those of the experimental items, with the exception that a picture of an inanimate object was presented in place of the picture of a family member.

5.3.4 Post-test

After the experimental test participants were given a test to make sure they understood the French gender agreement rules. The test consisted of four fill in the blank questions that explicitly asked participants to use French possessive determiners. All participants answered the gender agreement questions correctly.

1. Le père a pris ____ fille dans le centre commercial.
2. La fille faisait ses courses avec ____ père.
3. La mère a pris _____ fils dans le parc.
4. Le garçon a joué au football avec _____ mère.

5.3.5 Coding

Participant responses were coded according to the gender agreement for the possessive determiner used in their sentence completion. Responses that used possessive determiners with the correct gender agreement rules of the target language were coded as 0 and were labelled as *consistent agreement responses*. Responses that used possessive determiners that did not follow the gender agreement rules of the target language were coded as 1 and were labelled as *inconsistent gender agreement responses*. Examples of possible inconsistent gender agreement responses are as follows:

The boxer likes *her* sister.

L'infirmière aime *sa* frère.

The boxer likes *son* soeur.

L'infirmière aime *his* brother.

Responses were coded as NA for all other responses, including failure to respond in the correct target language, responding with a determiner that is not a possessive determiner, responding with no determiner, and the failure to respond at all.

5.4 Results

The vast majority of responses throughout the experiment were consistent with the gender agreement of the target language. There were very few instances in which participants used the inconsistent gender agreement in the one-language conditions with the exception of the French-French mismatch gender condition (see Table 7).

Table 7.

Results						
Conditions				Responses		
Gender matching	Source Language	Target Language	Language Condition	Consistent gender agreement	Inconsistent gender agreement	NA
Match	English	English	One-Language	252	0	4
Mismatch	English	English	One-Language	250	2	4
Match	French	French	One-Language	241	2	13
Mismatch	French	French	One-Language	228	9	19
Match	English	French	Two-Language	246	2	8
Mismatch	English	French	Two-Language	228	16	12
Match	French	English	Two-Language	239	2	15
Mismatch	French	English	Two-Language	223	21	12

Consistent with the Chapter 4, the dependent variable of congruent or incongruent gender agreement responses were coded as binomials (consistent = 0, inconsistent =1). Like Chapter 4, responses were modelled using logit mixed effects models. Every model reported for Experiment 5.1 attempted a maximum random effects structure of intercept and slope of participants and items. No models converged with the maximum random effects structure. Random effect structure was then simplified until models converged; models only converged using the minimum random effects structure of by participant and by item random intercepts.

The first model tests the three way interaction of source language (English vs French), target language (English vs French) and gender matching (matching vs mismatch). This model failed to converge likely because of the large number of congruent responses in comparison to incongruent responses. Because there were so few incongruent responses in the one-language condition I removed this condition from the analysis. Like in Chapter 4, because the combination of source language and target language conditions only yield two different variables, the source language and target language conditions were merged to create the switch variable (English to French vs. French to English). Using this data set and the new variable, I modelled the data using the interaction between gender matching and switch. Testing the two way interaction on the two-language condition revealed a main effect of gender matching but no interaction effect. Using a log-likelihood ratio χ^2 test, the model with the interaction of switch and gender as predictors is a better fit for the data set than the null model (see Table 8).

Table 8.

Predictor	Estimate	Standard Error	z value	<i>p</i>
Model with interaction of switch and gender matching as predictor: $\chi^2(3) = 33.113, p < .001, N = 976$				
(Intercept)	-7.299	1.212	-6.024	<.001
Gender: mismatch	2.755	0.906	3.041	0.002
Switch: French to English	-0.552	1.285	-0.430	0.667
Gender: mismatch x Switch: French to English	1.032	1.367	0.755	0.450
Modelled using data set from the two-language condition				

This means that there was no significant difference in incongruent responses in the gender mismatch condition when switching from English to French or when switching from French to English.

5.5 Discussion

Participants made incongruent gender agreement responses in the code-switched trials, and there was no significant difference whether the participants switched from English to French or from French to English. These results fall in line with the predictions of the Hybrid model. In our experiment the possessive determiner headed by the object NP requires gender information from the subject NP for its form. The Hybrid model assumes that for languages in which possessive determiners agree in gender with the possessor, gender information from the possessor remains active in order to become selected by the possessive determiner.

For selection of the correct possessive determiner, a monolingual English speaker is not likely to retrieve the gender from the possessed noun because there are no rules in English grammar to require the speaker to do so. Likewise, a monolingual French speaker is not likely to retrieve the gender from possessor noun because there are no rules in French grammar to require the speaker to do so. However, a bilingual speaker who speaks English and French will have two competing grammatical rules when assigning gender agreement on a possessive determiner. These two competing grammars will be represented in terms of featural nodes of the possessed and possessor nouns. For the English gender agreement the featural node will be attached to the gender of the possessor noun, for the French gender agreement the featural node will be attached to the gender of the possessed noun. Both English and French featural nodes will be activated and will send activation down to the form level, activating both forms of possessive determiners. Competition for selection occurs at the word-form level.

An unlikely possibility is that two effects are at play simultaneously. Regarding the first effect, it is possible that in a demanding task such as the current experiment, the cognitive load required caused a working memory overload and as a result the correct gender agreement rules were not always accessed. Research on working memory and language learning has shown that speakers with a higher working memory capacity are better at learning vocabulary in their L1 and L2, and have better reading and listening comprehension in their L1 (Daneman & Hannon, 2012; Engle, 2001). Working memory is also considered to be critical for linguistic tasks (Linck, Osthus, Koeth, & Bunting, 2014). In terms of L2 processing, larger

working memory capacities are correlated with L2 proficiency (Bergsleithner, 2011). Studies have also shown that working memory plays a role in L2 learners becoming highly proficient (Michael & Gollan, 2005). It may be that participants simply failed to access the gender agreement rules for French possessive determiners due to a heavy cognitive load and automatically processed the English agreement rules.

The second possible effect is that participants may have used the inconsistent gender agreement rules with English as the target language because the gender agreement features of English possessive determiners requires information from the controller noun outside of its maximal projection. The 4-M model states that morphemes outside of its maximal projection are only available from the ML. In the conditions with French as the source language and English as the target language, the gender agreement features of English possessive determiners require information from outside of its maximal projection. Because French is the ML in this condition, according the 4-M model the English possessive determiner should not be accessible, but the model makes no specifications regarding its agreement features. To summarise, the results of the current experiment may be due to a combination of a failure to retrieve the French gender agreement from memory, and a failure to retrieve the English possessive determiner because they are late system morphemes and French is the ML.

We cannot rule out the possibility that the native English participants used an inconsistent gender agreement when French was the target language because they were unfamiliar with the French gender agreement rules. However, as mentioned earlier, participants were given a French proficiency questionnaire after completion of the experiment that explicitly asked for examples of French gender agreement to which all participants responded correctly. Additionally, the majority of responses showed that participants used the correct gender agreement rules, including code-switched trials that required participants to switch from English to French. Moreover, participants also used an inconsistent gender agreement when switching from French into English, their native language. I now introduce the second experiment to clear up which interpretation is most plausible.

Experiment 5.2

French-English code-switching of possessive determiners

5.6 Rationale

In our second experiment we tested French-English bilinguals in the same experimental task. By using French-English bilinguals we could test whether the results from the current experiment are consistent with our first interpretation; that the result is due to a competition between both possessive determiner agreements. If this interpretation is correct then we should expect the same pattern of results with French-English bilinguals. If the second interpretation is correct, then there are two effects at play: in the English-French condition incongruent responses are due to cognitive load and the failure to access the correct French gender agreement, and in the French-English condition the incongruent responses are due to failures of accessing the English gender agreement because it is a late system morpheme. If this interpretation is correct, with French-English bilinguals there should be more incongruent responses in the French-English condition, and fewer incongruent responses in the English-French condition. The reasoning for this is because both the cognitive load effect and late system morpheme effect will negatively impact the access of English gender agreement, whereas there would be no negative impacts on retrieval of the French gender agreement.

5.7 Method

5.7.1 Participants

Twenty-four native French speakers (14 female, 10 male) were recruited from the George Square campus of the University of Edinburgh. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of English in order to participate. The participants had a mean age of 22.1 years ($SD = 2.02$) and reported having an average of 10.3 years of English language experience. Prior to running the experiment, participants were given a self-rated proficiency questionnaire for their English production, reading, and writing skills. On a five point scale, the participants averaged 4.71 in production, 4.54 in reading, and 4.46 in writing skills for an overall average proficiency score of 4.57. Participants were also given a language demographic questionnaire. Of the 24 participants 13 speak or are learning to speak a language in addition to French and English. Thirteen

participants speak French as their main language at home and 11 speak English as their main language at home. Finally, 22 of the 24 participants reported speaking English regularly at home. The participants spent an average of 3.4 years ($SD = 3.14$) in an English speaking county prior to testing. Participants received six British Pounds for their participation in this study.

5.7.2 Stimuli materials

The stimuli materials are the same as Experiment 5.1.

5.7.3 Procedure

Testing procedures are the same as Experiment 5.1.

5.7.4 Post-test

Like in Experiment 5.1, after the experimental test participants were given a short test to make sure they understood the English gender agreement rules. The test consisted of four fill in the blank questions that explicitly asked participants to use English possessive determiners. All participants answered the gender agreement questions correctly.

1. The father took _____ daughter to the mall.
2. The girl went shopping with _____ father.
3. The mother took _____ son to the park.
4. The boy played football with _____ mother.

5.7.5 Coding

Participant responses were coded in the same way as Experiment 5.1.

5.8 Results

Table 9.

Results						
Conditions				Responses		
Gender matching	Source Language	Target Language	Language Condition	Consistent gender agreement	Inconsistent gender agreement	NA
Match	English	English	One-Language	185	0	7
Mismatch	English	English	One-Language	186	0	6
Match	French	French	One-Language	189	0	3
Mismatch	French	French	One-Language	188	0	4
Match	English	French	Two-Language	181	1	10
Mismatch	English	French	Two-Language	175	6	11
Match	French	English	Two-Language	176	3	13
Mismatch	French	English	Two-Language	169	9	14

Like Experiment 5.1, the vast majority of responses used the correct gender agreement rules for the target language. Unlike Experiment 5.1, inconsistent responses were only produced in the two-language condition (See Table 9).

The models for Experiment 5.2 were first attempted with maximum random effects structure of random intercept and slope by participants and by items. Like with Experiment 5.1, data analysis of Experiment 5.2 found no models converging with the maximum random effects structure. Random effect structure was then simplified until models converged; models only converged using the minimum random effects structure of by participant and by item random intercepts.

Table 10.

Predictor	Estimate	Standard Error	z value	p
Model with interaction of switch and gender matching as predictor: $\chi^2(3) = 6.424$, $p = 0.093$, $N = 720$				
(Intercept)	-5.561	1.098	-5.066	<.001
Gender: mismatch	1.826	1.140	1.601	0.109
Switch: French to English	1.135	1.210	0.938	0.348
Gender: mismatch x Switch: French to English	-0.673	1.371	-0.491	0.624

Modelled using data set from the two-language condition

Because there were no inconsistent responses in the one-language condition, the one-language condition was removed from data analysis. Like in the data analysis for Experiment 5.1, the combination of source language and target language conditions were turned into a new switch variable (English to French vs. French to English). Using the data from the two-language condition and the new switch variable, I tested a model with the interaction of switch (English to French vs. French to English), and gender matching (match vs mismatch) as predictors. The model revealed no interaction effect and no main effect, and a log-likelihood ratio χ^2 test showed that the model with the interaction of switch and gender matching as predictors did not fit the data significantly better than the null model (see Table 10).

I tested an additional model using only gender matching as a main effect. This model revealed a significant main effect of gender matching ($p = .029$). Using a log-likelihood ratio χ^2 test, the model with gender matching as a predictor is a significantly better fit to the data than the null model (see Table 11). The significant main effect of gender matching shows that participants used inconsistent responses more often in the mismatch gender condition than in the matching gender condition. During code-switching the effect of gender matching occurred with no significant

difference when switching from English to French or when switching from French to English.

Table 11.

Predictor	Estimate	Standard Error	z value	p
Model with gender matching as predictor: $\chi^2(1) = 4.92$, $p = .027$, $N = 720$				
(Intercept)	-4.881	0.658	-7.421	<.001
Gender: mismatch	1.368	0.628	2.180	.029
Modelled using data set from the two-language condition				

5.9 Discussion

The results from Experiment 5.2 show that French native speakers made incongruent responses in the code-switched trials and that the incongruent responses were more likely to occur in the mismatch gender condition. Because Experiments 5.1 and 5.2 lacked the statistical power to run the logit mixed effects model with the intended three-way interaction the next section is a combined analysis of the data from both experiments.

5.10 Combined analysis

Because both experiments were tested with the same stimulus materials, I combined the data from Experiment 5.1 and Experiment 5.2 into a new data set with a new predictor of native language. The combined data analysis was conducted in the same manner as the individual analyses of Experiments 5.1 and 5.2. Every model reported in the combined analysis attempted a maximum random effects structure of intercept and slope of participants and items. When the maximum random effects did not converge, the random effect structure was then simplified until models converged.

On the full data set the first model tested was the three way interaction of source language (English vs French), target language (English vs French), and gender matching (matching vs mismatch). The maximum random effects structure did not converge, so the model was tested using random intercept and slope by participants and random intercept by items. With the simplified random effects structure the model converged but did not yield any significant effects.

In the two experiments there were very few incongruent gender agreement responses in the one-language condition so I removed this condition for the remainder of the analysis. For the two-language data from both experiments I created

the switch variable (English-French vs. French-English) in the same manner as in the individual analyses. With the new switch variable I tested a model using the interaction of gender matching and switch. The model revealed a main effect of gender matching but no interaction effect. Using a log-likelihood ratio χ^2 test, the model with the interaction of gender matching and switch is a better fit for the data than the null model (see Table 12).

Table 12.

Predictor	Estimate	Standard Error	z value	p
Model with interaction of switch and gender matching as predictor: $\chi^2(3) = 6.424, p < 0.001, N = 1696$				
(Intercept)	-5.793	0.694	-8.342	<.001
Gender: mismatch	2.238	0.666	3.362	<.001
Switch: French to English	0.330	0.794	0.416	0.678
Gender: mismatch x Switch: French to English	0.008	0.865	0.009	0.993

Modelled using the combined data from Experiment 5.1 and 5.2 in the two-language condition

This means that the incongruent responses occurred in the gender mismatch condition, and there was no significant difference when switching from French to English or from English to French.

The Hybrid model and the MLF model make no claim regarding how the native language of the speaker would affect the responses. I ran a final model using native language as predictor with maximum random effects structure of random intercept and slope by participants and by items. Native language did not yield a significant effect as a predictor ($p = .315$).

5.11 General discussion

In two code-switching experiments I investigated whether bilingual speakers access English and French possessive determiners differently because of the different gender agreement rules between English and French. In the first experiment we observed that native English speakers were likely to use an inconsistent gender agreement in code-switched trials in the mismatch gender conditions regardless of which language was the source or the target language. I offered two potential explanations for this result. The first interpretation was consistent with the predictions of the Hybrid model. The lemma representing the possessive determiner is attached to gender and number feature nodes to determine which gender or number it must agree with. The gender feature nodes of the possessive determiner lemma receives activation from the gender feature nodes of both the possessor noun for

English gender agreement, and the possessed noun for the French gender agreement. In the one-language trials this was a straight forward task; activation came from the active language making selection of the target possessive determiner less competitive. That is, in one-language trials in which French was the active language, activation of the possessive determiner gender feature node came strictly from the French possessed noun. In one-language trials in which English was the active language, activation of the possessive determiner gender feature node came strictly from the English possessor noun. In code-switched trials both languages are active which leads to activation from both the possessor and possessed nouns. In the mismatch gender conditions this leads to activation of both gender feature nodes of the possessive determiner. Because both the possessor and possessed nouns activated the different gender nodes of the possessive determiner, activation is fed down to the word-form level, activating all four forms of possessive determiners (e.g., *his*, *her*, *son*, *sa*). The four activated word forms then compete for selection.

The second interpretation offered the possibility of two potential effects at work; one effect causing participants to use the incongruent gender agreement when completing sentences in French, and the other effect causing participants to use the incongruent gender when completing sentences in English. The first effect I suggested is that participants used the incongruent gender when switching from English into French because the experimental task was a difficult task that required a high cognitive load. Because of the high cognitive load, participants were sometimes unable to access the gender agreement rules of French, their second language. The second effect I suggested is that participants used the incongruent gender when switching from French into English because the English possessive determiner agrees in gender with the possessor which is outside of the head constituent of the possessive determiner. This explanation is in line with the MLF model; the English possessive determiner is a late system morpheme and can only come from the ML. In this condition French is the ML, and therefore the English possessive determiner should not be able to access the correct gender agreement feature. Experiment 5.2 tested native French speakers with the same experimental paradigm. If our first interpretation, the interpretation of the Hybrid model, is correct there should be a similar pattern of results as for Experiment 5.1. If our second interpretation was

correct I argued that we would expect to see a different pattern of results with French native speakers. Specifically, in the mismatch gender condition we should see a higher number of incongruent gender agreement responses when English is source language and French is the target language. The reason for this is because the cognitive load effect and the late system morpheme effect would act on English as the target language, whereas for native English speakers the cognitive load effect acted on French as the target language, and the late system morpheme effect acted on English as the target language.

Like Experiment 5.1, the combined analysis showed no significant difference when switching from English to French or from French to English. This goes against our second interpretation, that there are two effects acting simultaneously. The MLF model predicted that there would be more incongruent gender agreement responses when switching from French to English. However, we must consider that (1) the experiment may not have been suitable to test the MLF model, and (2) the experiment lacked statistical power. First, the current experiment did not test in which language the possessive determiners would be produced. Instead, the experiment tested whether agreement features would be accessible from the controller noun in the ML or the controller noun in the EL. The experiment found that agreement features from both languages were accessible. Second, the lack of statistical power did not allow the logit mixed effects model with the three-way interaction to converge, thus the predictions of the MLF model were unable to be properly tested.

The results support the Hybrid model predictions. The Hybrid model adopts the architecture of the lemma stratum from the Hartsuiker and Pickering (2008) model. Though the Hartsuiker and Pickering (2008) model does not take a stance in how determiners are selected, the Hybrid model assumes that noun lemmas indirectly elect determiners through the featural nodes of the noun lemma at the lemma level. The activated featural nodes then feed activation to the featural node of the possessive determiner. Recall that in determiner selection, competition for selection occurs at the word-form level. During code-switched trials the featural node of the possessive determiner receives activation from both the possessor noun and the possessed noun. In the mismatch gender condition the featural node of possessive

determiner gets activated from both genders. The masculine and feminine gender nodes then feed activation down to the word-form level activating the masculine and feminine word-forms of both languages. The feminine featural node activates the forms *sa* and *her* from both languages, and the masculine featural node activates the forms *son* and *his* from both languages. Selection of the target language possessive determiner occurs through activation of the language node that activates the appropriate forms for that language. The determiner form with the highest level of activation is then selected.

5.12 Chapter summary

In the two experiments carried out on possessive determiner selection the results reveal that the coactivation of different syntactic rules can act upon the possessive determiner lemma causing responses that are incongruent to the syntactic rules of target language. The results showed that the incongruent gender agreement responses occur in the gender mismatch condition and found no difference when switching from English to French or from French to English. The results support the Hybrid model of bilingual language production.

Chapter 6

An investigation of asymmetric language use of case-marked determiners during German-English code-switching

6.0 Chapter overview

Continuing from the previous chapter, the current chapter further examines the way in which late outsider system morphemes are processed during code-switching. This chapter specifically examines case-marked morphemes in the production of German determiners during code-switching of German and English. German determiners are marked for case whereas English determiners are not. The motivation for the current experiment is to test the MLF model and its predictions in regards to the code-switching of late system morphemes. In these experiments participants are forced to code-switch before an accusative NP (Experiment 6.1) and before a dative NP (Experiment 6.2). Finally I report and discuss the results and the implications to the Hybrid model and the MLF model.

6.1 Theoretical grounds

The current chapter investigates the nature of determiner selection in bilingual language production and whether case-marking is retrieved in a similar manner as gender and number features. The literature on determiner production has investigated the role of gender and number features at length; however the role of case has been largely ignored. For languages with morphologically rich determiners such as French and Spanish, number and gender features of the head noun leads to activation of the number and gender features of the target determiner. These features then lead to activation of the appropriate determiner form at the word-form level; competition for selection occurs at the word-form level. English determiners are limited in their form: the definite determiner has one form *the*, and the indefinite determiner has two forms which depend on the phonology of the following noun, *a*

and *an*. German however has a large set of determiners which depend on gender, number, and case (see Table 13).

Table 13.

German definite determiners

	Masculine	Feminine	Neuter	Plural
Nominative	der	die	das	die
Accusative	den	die	das	die
Dative	dem	der	dem	den
Genitive	des	der	des	der

Using a forced code-switching task, I investigate the distribution of determiner production of German-English bilinguals. Of particular interest is case-marking on German determiners and how case may affect the way in which determiners are selected for production. There are two accounts on how case may affect production of determiners. The Hybrid model treats case the same as gender and number features. For languages with case-marked determiners, verbs mark the noun for case via the case featural nodes. For the determiners, case features are retrieved through connections to the case featural node of the head noun. Consistent with competition for selection accounts of determiner selection (Dhooge, et al., 2016; Jescheniak, Schriefers, & Lemhofer, 2012; 2014), the Hybrid model assumes case-marked determiners undergo the same competition for selection process. Lemmas from languages with case-marking will have an additional featural node for case. In German, lemmas representing words that are marked for case such as nouns, adjectives, and determiners, will be connected to this additional case feature node. For example, at the lemma level a German accusative noun will receive activation of its accusative feature node and its appropriate gender feature node. Recall that determiners are selected by indirect election, through the features of the head noun. By the process of indirect election, the determiner lemma will receive activation of its accusative case feature node and gender feature node from the head accusative noun. These feature nodes then send activation down to the form level and selection of the target determiner takes place at the form level.

For bilinguals code-switching in German and English, competition for selection of determiners will occur between languages meaning that English determiners can be produced with German nouns and German determiners can be produced with English nouns. For simplicity let us consider definite determiners.

Because English only has one definite determiner, it will receive all the activation from the target lemma and all other semantically related lemmas that also receive activation from conceptual level. Because German has a number of definite determiners that differ depending on gender, number, and case, the activation from the target lemma and all other semantically related lemmas will lead to activation being distributed to other determiners depending on the features of the activated lemmas. This asymmetry in activation of determiners results in English determiners being more likely to be selected than German determiners. In fact in a corpus of Italian-Swiss German code-switching, Preziosa-Di Quinzio (1992) shows that German nouns are often accompanied by Italian determiners; however Myers-Scotton (2001) suggests this is due to case-marking rather than the number of determiners.

According to the 4-M model, determiners are generally considered early system morphemes even when they require gender and number features, because these features are accessed from the head noun. However Myers-Scotton (2002) argues that some morphemes can be *multimorphemic*. A morpheme becomes multimorphemic when it is an early system morpheme with properties that rely on information from outside of its head constituent for its form. German determiners are multimorphemic because in addition to gender and number, their form depends on case. The 4-M model argues case-marked morphemes are outsider system morphemes because they are accessed at a stage of language production that follows lexical selection. Specifically, they depend on information from the argument structure of the verb or preposition that assigns their case (Myers-Scotton, 2001). According to the 4-M model this information is not available until larger constituents are formed which occurs at a later stage, during morphological encoding (Myers-Scotton, 2002). Conversely, determiners in English, French, and Spanish are early system morphemes because their form only depends on the properties of their head noun. According to the MLF model, when switching from English as the ML, case marked determiners will not be available because they require information from outside of their head constituents to receive their grammatical function. To put it differently, if English is the ML then speakers will avoid using German determiners whose form relies on case information. Experiment 6.1 investigates code-switching

with accusative NPs. For German nouns in the accusative case only the masculine nouns change case-marked endings from the nominative endings (e.g., *Löwe* → *Löwen*), and this is also true for case-marked endings of adjectives (e.g., *rote* → *roten*), and determiner forms (e.g., *der* → *den*). Experiment 6.2 investigates code-switching with dative NPs. In the dative case all genders change case-marked endings and forms from the nominative case.

Experiment 6.1

English-German code-switching and production of accusative determiners

6.2 Rationale

The current experiment is a sentence completion task exploring an instance of English-German code-switching in which critical trials require participants to code-switch before producing an accusative NP. Participants listened to sentence fragments in either English or German and were asked to repeat the sentence fragment and complete the sentence in English or German by using a picture that appeared after initial voice onset. Participants were explicitly told to use definite determiners. German determiners hold gender and case information whereas the English determiners do not. As noted above, in the accusative case only the masculine gender has a different form from its default nominative form. I exploit this difference between the masculine determiner and the feminine and neuter determiners to see if it results in specific patterns of use after code-switching.

6.2.1 Predictions

Unlike the MLF model, the Hybrid model makes no claims in regards to when case information is available. Rather, the Hybrid model assumes that case features are processed in the same manner as number and gender features. During language production, the verb marks nouns for case via links to case featural nodes. The noun then indirectly elects the determiner, and the case features of the noun activates the case featural nodes of the determiner. The Hybrid model assumes that determiners compete for selection at the word-form level, and that during code-switching determiners between languages are activated and compete for selection. In regards to the current experiment, the Hybrid model makes no specific predictions because it is not yet fully understood how case features interact during the competition for selection of determiners.

The 4-M model states that case-marking is an outsider system morpheme. The MLF model states that outsider system morphemes cannot come from the EL. Because the German masculine determiner changes form from the nominative case to the accusative case, the MLF model predicts that when English is the ML, English determiners will be used with German masculine accusative nouns more often than German determiners will be used with German masculine accusative nouns. In other words, the MLF model predicts that when switching from English to German, English determiners are likely to accompany German masculine nouns whereas German determiners are likely to accompany German feminine and neuter nouns.

6.3 Method

6.3.1 Participants

Twenty native German speakers (16 female, 8 male) were recruited from the George Square campus of the University of Edinburgh. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of English in order to participate. The participants had a mean age of 22.7 years ($SD = 3.27$), and have an average of 11.7 years of English language experience. Participants were also given a language demographic questionnaire. Of the 20 participants 10 speak or are learning to speak a language in addition to German and English. Fourteen participants speak German as their main language at home and six speak English as their main language at home. Finally, 19 of the 20 participants reported speaking English regularly at home. The participants spent an average of 2.0 years ($SD = 1.97$) in an English speaking country prior to testing. Participants received 6.50 British Pounds for their participation in this study.

6.3.2 Stimuli materials

Conditions			
Source Language	Target Language	Noun Gender	Example
English	English	M*	In the garden, the cat caught... the blue bird
English	English	F*	Before the race, the runner filled... the grey bottle
English	English	N*	Not paying attention, the driver hit... the red car
German	German	M	Im Garten fing die Katze... den blauen Vogel
German	German	F	Vor dem Rennen füllte der Läufer... die graue Flasche
German	German	N	Da er nicht aufpasste, rammte der Fahrer... das rote Auto
English	German	M	In the garden, the cat caught... den blauen Vogel
English	German	F	Before the race, the runner filled... die graue Flasche
English	German	N	Not paying attention, the driver hit... das rote Auto
German	English	M*	Im Garten fing die Katze... the blue bird
German	English	F*	Vor dem Rennen füllte der Läufer... the grey bottle
German	English	N*	Da er nicht aufpasste, rammte der Fahrer... the red car

* For English nouns, the gender depicted is the gender of German translation equivalent

Experimental items were created to make four language versions: an English-English version, a German-German version, a German-English version, and an English-German version. The experimental items were created by combining sentence fragments with pictures to act as complete sentences. The sentence fragments were created by combining a short subordinate clause indicating a location with transitive sentences with the final NP removed (e.g., *Because of the mess, the girl grabbed...*). In order to ensure the source language became the ML of the utterance, a subordinate clause was added to all the experimental sentences. In English the subordinate clause did not impact the structure of the remainder of the sentence; however, in German the addition of the subordinate clauses changed the surface structure of the sentence. This change in surface structure of the German sentences is referred to as verb-second word order. Verb-second word order causes the finite verb of a clause or sentence to be placed in the second position after a major constituent. In our experimental sentence the verb occurs after the subordinate clause, before the subject NP. This difference in surface structure between the English and German sentences ensured that the grammatical frame was set at the beginning of each trial, and that the source language was the ML.

Seventy-two sentence fragments were created, and pictures of 72 objects were selected to act as the object in the final NP of the sentence fragments (e.g.,

Because of the mess, the girl grabbed... [picture of red broom]). The pictures were specifically chosen so that in German, the list of 72 objects are best described by 24 masculine nouns, 24 feminine nouns, and 24 neuter nouns. The 72 pictures were duplicated to create two sets: one set was given a circular border and the other set was given a square border. The shape of the border around the picture acted as a language prompt, the square frame instructing participants to name the picture in the same language as the sentence fragment, and the circular frame instructing participants to switch languages to name the picture.

The English-English version of items was created by combining the English sentence fragments and the pictures with square borders. The German-German version was created by combining the German sentence fragments and the pictures with square borders. The German-English version was created by combining the German sentence fragments and the pictures with circular borders. Finally, the English-German version was created by combining the English sentence fragments and the pictures with circular borders. Each set consisted of 72 sentence-picture pairs. A Latin Square design was used so that four unique lists of 72 items was created.

Fillers were created using the same principle as the experimental items, but without any items using the accusative case. Two types of fillers were created, numeral adjectives and emotional fillers. For the numeral adjective fillers, seventy-two sentence-picture pairs were created using sentence fragments and images of multiples of the same object. The number of identical objects in one picture ranged from two to nine. For these fillers participants were asked to complete the sentence by naming the number of items in the pictures (e.g., *In the curry there are...* [picture of nine chilies]). For the emotional fillers, seventy-two picture pairs were created by combining sentence fragments with emoticons. Five emoticons were created, each to show an obvious depiction of anger, confusion, happiness, sadness, and surprise. For these fillers, participants were asked to complete the sentence by using the emotion depicted (e.g., *Because of the lies, the voters were...* [angry emoticon]). In total there were 144 fillers and 72 experimental items making a total of 216 items per participant.

6.3.3 Procedure

Prior to testing, participants filled out a demographic questionnaire including a self-evaluation of their English proficiency. Instructions were presented entirely in English. The experiment was a sentence completion task in which participants listened to a sentence fragment and were asked to repeat the fragment and complete the sentence by naming the picture that appeared on the screen. For each trial a fixation point was presented for 500 milliseconds. Participants were then presented a spoken sentence fragment in their headphones. As soon as the participant spoke into the microphone, the voice key triggered the picture to display on the screen. Participants were given 7000 ms to complete their response before the next trial began.

6.3.4 Coding

For each condition, responses were coded according to the language in which the determiner was presented. Responses were coded as determiners for definite articles (the; die, das, den). If the determiner was spoken in the target language, the response was coded as 0. If the determiner was spoken in the non-target language, the response was coded as 1. Responses were coded as NA and removed from data analysis for all other responses, including responding without a determiner, responding in the wrong language, and failing to respond at all. Results were discarded for participants who had a rate of other responses higher than 20% of all responses. Three participants were removed from data analysis because of the number of other responses.

6.4 Results

As expected the results show that there were no instances of non-target language determiners in the one-language condition. Additionally, there was only one instance of a non-target language determiner when the target language was English. That is, only once was a German determiner used in place of an English determiner when German was the source language and English was the target language. The remainder of non-target determiner responses occurred when English was the source language and German was the target language. The majority of English determiners were produced before German masculine nouns (see Table 14).

Table 14.

Experiment 6.1: German-English bilinguals' responses.

Results						
Conditions				Responses		
Source Language	Target Language	Target Noun Gender	Language Condition	Target Language DET	Non-Target Language DET	NA
English	English	M*	One-Language	143	0	1
English	English	F*	One-Language	136	0	8
English	English	N*	One-Language	126	0	18
German	German	M	One-Language	142	0	2
German	German	F	One-Language	126	0	18
German	German	N	One-Language	136	0	8
English	German	M	Two-Language	117	19	8
English	German	F	Two-Language	119	6	19
English	German	N	Two-Language	123	7	14
German	English	M*	Two-Language	133	0	11
German	English	F*	Two-Language	121	0	23
German	English	N*	Two-Language	122	1	21

*For English nouns, the gender depicted is the gender of the German translation equivalent

The responses in the current experiment were coded as binomials (target language determiner = 0, non-target language determiner = 1). Responses were modelled in the same manner as in Chapters 4 and 5, by using logit mixed effects models with the glmer function of the lme4 package version 1.1.12. Every model was attempted using the maximal random structure. When using the maximal random structure the models did not converge. The random structure was simplified until the models converged. The models reported below only converged using the minimal random structure of by participant and by items random intercepts.

Because there were no non-target language determiner responses in the one-language condition I removed this condition from data analysis. Like in Chapters 4 and 5, the removal of the one-language condition required the creation of a new variable. Without the one-language condition, when the source language is English the target language is always German, and when the source language is German the target language is always English. Because of this I created a new variable called switch. The switch variable has two levels, English to German and German to English. For the analysis of the two-language condition, gender is a valid predictor because both English and German lemmas are activated regardless of the source or target language. Because lemmas from both languages are activated, the gender

features are activated when German is the source language and English is the target language, and when English is the source language and German is the target language.

The raw data shows that participants made more non target language determiner responses for masculine nouns when switching from English to German. Because in the accusative case feminine and neuter determiners do not change forms from their default nominative forms, I consider both feminine and neuter genders as one condition. To test whether this is significant I ran a logit mixed effects model with the interaction of switch and gender as predictors. The model revealed significant effects of gender ($p = .012$) and of switch ($p = .022$) but found no significant interaction effect (see Table 15).

Table 15.

Predictor	Estimate	Standard Error	z value	<i>p</i>
Model with interaction of gender and switch as predictors: $\chi^2(3) = 21.808$, $p < .001$, $N = 770$				
(Intercept)	-3.841	0.605	-6.351	<.001
Gender: Masculine	1.495	0.597	2.506	0.012
Switch: German to English	-1.971	0.861	-2.289	0.022
Gender: Masculine x Switch: German to English	-17.236	193.518	-0.089	0.929

Comparing the AIC and the BIC of the model with the interaction of gender and switch against the AIC and the BIC of the null model it is confirmed that the model with gender and switch interaction as predictors (AIC = 256.21, BIC = 284.09) is the model of best fit compared to the null model (AIC = 272.02, BIC = 285.96).

6.5 Discussion

The results of Experiment 6.1 demonstrated that participants responded with significantly more non-target language determiners when switching from English to German than switching from German to English, and that there were significantly more non-target language determiners used before masculine nouns than before feminine and neuter nouns. This pattern of results is consistent with the predictions of the MLF model.

According to the 4-M model, because German masculine determiners change form in the accusative case compared to its default nominative form, it is a late

outsider system morpheme whereas the feminine and neuter determiners are early system morphemes. The MLF model makes the claim that late system morphemes can only come from the ML. As noted above in section 6.3.2, I manipulated the experimental sentences so that the source language became the ML. Because I manipulated the source language to become the ML, the MLF predicted that when switching from English to German there would be more English determiners used before German masculine nouns than before German feminine or neuter nouns. This prediction was supported by the results of the current experiment.

The Hybrid model made no predictions in the current experiment because it is yet not fully understood how case features behave during determiner selection. The Hybrid model assumes competition for selection between determiners at the word-form level, and that case features are treated in the same manner as gender and number features. That is, verbs mark nouns with case features though the case featural nodes and the case features of nouns are linked with the case featural nodes of determiners. The accusative noun is marked accusative by the verb, and the noun indirectly elects the accusative determiner. The results of the current experiment can be explained by the competition between determiner forms in English and in German. Studies have shown that syntactic features from lemmas of both languages are activated and compete for selection during language production (Hartsuiker & Pickering, 2008). The activation and competition of selection of syntactic features occurs with greater magnitude in code-switched trials, but has also been found during one-language trials (Hatzidaki et al., 2011). In the current experiment participants were using both languages throughout the experimental session so both languages were highly activated. Because the experiment involved the repeated use of English and German, when participants produced any accusative NP there is a potential for competition between the English *the*, and the German accusative forms *das*, *die*, *den*. Because English only has one definite determiner, it will become highly activated for each experimental trial, whereas the German determiner will only receive heightened activation for when the picture name is of the same gender.

Under the Hybrid model, when participants switch from English to German, both languages are activated and compete for selection. This is true for lexical items and syntactic structures. When a participant switches from English to German before

an accusative NP, the target noun lemma from both languages will be activated. Consider the sentence, '*the witch rides the red broom*' in which '*the red broom*' is represented by a picture the participant is expected to name in German. The resulting sentence should be '*the witch rides den roten Besen*'. However, because of competition for selection, the English and German lemmas representing the target noun become activated. The features of the English noun lemma are activated; the definiteness feature and the singular number feature. The features of semantically related lemmas are also active. In English this is likely to only by the same definite feature and the singular number feature which in turn activate the same definite determiner. In German the process is more complex. The features of the German noun lemma are activated: the definiteness feature, the masculine gender feature, the singular number feature, and the accusative case feature. The semantically related lemmas are also activated in German. This will result in the potential activation of three different determiners. This spreading of activation results in a lower level of activation for the target German determiner compared to the target English determiner. Because of competition for selection, English determiners are selected even when the German target noun is selected.

We must also consider how the verb-second word order in the German experimental sentences may have influenced the results. Recall that the experimental sentences included a subordinate clause to change the surface structure of the German sentences. Because of the verb-second word order, the verb was placed after the subordinate clause and before the subject NP. This manipulation was to ensure the source language became the ML, but it may have had an unintended effect on the results. During the switch trials, the English accusative NP was produced following the German NP whereas the German accusative NP was produced following the English verb. The Hybrid model assumes the case features are accessed at the lemma level in the form of featural nodes and that case is marked by the verb. If case features are marked by the verb, then during the switch trials the German accusative NP is closer in proximity to the verb than the English accusative NP. If we assume that proximity affects how well case features are accessed, then the German accusative NP would benefit from appearing directly after the verb. However, the results showed that during switch trials participants produced more English

determiners in German accusative NPs than German determiners in English accusative NPs, and English determiners are not marked for case. Therefore, it appears as though the verb-second word order did not have an effect on the results.

Table 16.

Instances of determiners in Experiment 6.1

Determiner form	die	das	der	den	dem	the
Number of occurrences	60	48	156	24	37	316
Percentage of occurrences	9.4%	7.5%	24.3%	3.7%	5.8%	49.3%

The magnitude of this effect may also be increased due to the frequencies of the determiners used throughout the experiment. Analysing the stimuli materials, the German determiners, *die*, *das*, *der*, and *dem* occur throughout the sentences produced by participants. In the current experiment the German nominative masculine determiner *der* occurs the most frequently of all German determiners by a considerable amount (see Table 16). The majority of the instances of *der* occur within the subordinate clause of the sentence fragments. Because *die* and *das* corresponds to the form for nominative and accusative case of feminine and neuter determiners, they both occur with the second most frequency throughout the experiment. The German masculine and neuter dative determiner *dem* only appears within subordinate clauses of the sentence fragment and occurs relatively infrequently. Finally, the German masculine accusative determiner *den* occurs the least throughout the experimental session. The distribution of determiners used throughout the experiment is similar to the distribution of determiners used during natural language production (see Table 17). The main difference between the distribution of determiners in the experimental session and in natural language is that in the experimental session there are fewer instances of *die* and *das* in comparison to *der*. However, both *den* and *dem* have the lowest distribution in the experimental session and in natural language production.

Table 17.

Frequency of German determiners in language

Determiner form	die	das	der	den	dem
Number of occurrences per 100,000 words	1,614	2,031	1,124	597	300

(Buchmeier, 2009)

When participants were asked to produce a German accusative NP following an English preamble, the English determiner *the* will have the highest level of activation compared to the other German determiners because there are more German determiners. For masculine accusative NPs, the English definite determiner *the* will compete with the German masculine accusative determiner *den*. The higher frequency of English definite determiners occurring throughout the experimental session leads to a higher level of activation in comparison to the German masculine accusative determiner which may have resulted in the number of English determiners used before German masculine accusative nouns. Interestingly, in all instances in which a German determiner was produced before an accusative masculine noun, the correct case-marked determiner was produced. Under the competition for selection account it might be expected that the German nominative masculine determiners would also compete for production in masculine accusative noun phrases. This raises questions as to whether the competition between the forms of determiners differs depending on case. Perhaps a more likely explanation is that the case feature of nouns delivers a higher level of activation to the determiners compared to the activation levels delivered by the gender and number features of nouns. Though this pattern was not significant, it may be worth considering that the tendency to use the English determiner in German masculine accusative NPs could be due to the competition between the highly activated English determiner and the less frequently used German masculine accusative determiner. Furthermore, participants used the appropriate case-marking on adjectives even when they followed English determiners. In sum, the results from Experiment 6.1 show evidence to support the Hybrid model. To expand on these findings Experiment 6.2 investigates whether a similar trend of code-switching can be found using dative case-marked determiners.

Experiment 6.2

English-German code-switching and production of dative determiners

6.6 Rationale

The current experiment is a sentence completion task similar to that of Experiment 6.1 forcing participants to code-switch before a dative NP in critical trials. Experiment 6.2 only uses masculine and feminine dative nouns.

6.6.1 Predictions

From the results of Experiment 6.1 we now have an understanding of how case is accessed during determiner selection. Considering the results are consistent with a competition for selection account of determiner selection, including case features, the Hybrid model predicts we will observe a similar pattern of results as in Experiment 6.1. Specifically that there will be more English determiners produced before German nouns than German determiners before English nouns. The MLF model predictions for Experiment 6.2 are the same as the Hybrid model, but for different reasons. In German masculine and feminine dative determiners have a different form than their nominative form, and therefore are both late system morphemes. Because of this the MLF model would predict more English determiners before both masculine and feminine German dative nouns.

6.7 Method

6.7.1 Participants

Twenty native German speakers (12 female, 8 male) were recruited from the George Square campus of the University of Edinburgh. During participant recruitment it was stressed that the speakers must have an intermediate to advanced level of English in order to participate. The participants had a mean age of 21.8 years ($SD = 2.52$), and have an average of 9.2 years of English language experience. Participants were also given a language demographic questionnaire. Of the 20 participants eight speak or are learning to speak a language in addition to German and English. Eleven participants speak German as their main language at home and nine speak English as their main language at home. Finally, 17 of the 20 participants reported speaking English regularly at home. The participants spent an average of 3.1 years ($SD = 2.13$) in an English speaking country prior to testing. Participants received six British Pounds and fifty pence for their participation in this study.

6.7.2 Stimuli materials

Conditions			
Source Language	Target Language	Target Noun Gender	Example
English	English	F	In the morning, the boy advised... the waitress
English	English	M	In the morning, the boy advised... the pirate
German	German	F	Am Morgen, riet der Junge... der Kellnerin
German	German	M	Am Morgen, riet der Junge... dem Piraten
English	German	F	In the morning, the boy advised... der Kellnerin
English	German	M	In the morning, the boy advised... dem Piraten
German	English	F	Am Morgen, riet der Junge... the waitress
German	English	M	Am Morgen, riet der Junge... the pirate

Similar to Experiment 6.1, experimental items were created to make four language versions; an English-English version, a German-German version, a German-English version, and an English-German version. The experimental items were created by combining a subordinate clause with pictures to act as a complete sentence. Drawings of eight characters acted as the subject of the sentence; a little boy, a little girl, a young man, a young woman, a middle aged man, a middle aged woman, an old man, and an old woman. I will refer to these as the subject characters. Drawings of eight stereotypical gendered characters acted as the indirect object; a boxer, a pirate, a doctor, a sailor, a nurse, a waitress, a witch, and a ballerina. I will refer to these as the dative characters. Twenty verbs were specifically chosen to be German dative verbs that takes an optional direct object NP or PP but maintains the dative case if they were excluded. These verbs were then translated into English. Twenty-four subordinate clauses indicating a time were then translated to German (e.g., *In the morning...*). The English subordinate clauses were recorded by a male English native speaker and the German subordinate clauses were recorded by a male German native speaker.

Target sentences were created by combining a subordinate clause with a subject character, a dative verb, and a dative character. Because of the verb-second word order in German, in the German sentences the verb occurs after the subordinate clause and before the subject NP. The drawings of the target dative character were given a circular or square border to act as a language switch cue. If the character was surrounded by a square border participants were required to complete the sentence in the same language. If the character was surrounded by a circular border participants

were required to switch languages before naming that character. Sixty-four target sentences were created using all combinations of subject character and the dative character.

The English set of items was created by combining the English subordinate clauses with the English dative verbs and the 64 combinations of subject-dative character pairs with the dative characters surrounded by square borders. For each language set verbs were randomly assigned to each character pair, 16 verbs were presented three times per list and four of the verbs were presented four times per list. The German set was created by combining the German subordinate clauses with German dative verbs and the character pairs with the dative characters surrounded by a square border. The German-English set was created by combining the German subordinate clauses with dative verbs and the character pairs with the dative character surrounded by a circular border indicating a language switch. Finally, the English-German set was created by combining the English subordinate clauses with English dative verbs and the character pairs with the dative character surrounded by a circular border. A Latin Square design was used so that four unique lists of 64 items was created.

As in Experiment 6.1, the fillers were created using the same principle as the experimental items, without any items using the accusative or dative case. The fillers were simple sentences including a subordinate clause and indicated an emotion the subject character was feeling. Emoticons were created to depict anger, confusion, happiness, sadness, and surprise. Sixty-four target emotion sentences were created by combining the same subordinate clauses from the experimental items with the verb *to be* and subject-emotion picture pairs. For these fillers, participants were asked to complete the sentence by using the emotion depicted. Four language sets were created with the fillers in the same manner as the experimental items, but were repeated twice so that participants saw two fillers per experimental item. In total there were 128 fillers and 64 experimental items making a total of 192 items per participant.

6.7.3 Procedure

Prior to testing, participants filled out a demographic questionnaire including a self-evaluation of their English proficiency. Instructions were presented entirely in

English. The experiment was a sentence completion task in which participants listen to a subordinate clause, were asked to repeat it and complete the sentence by using the verb and the two characters that appeared on the screen. For each trial a fixation point was presented for 500 milliseconds. Participants were then presented a spoken subordinate clause in their headphones. The infinitive form of a dative verb was presented at the same time as the subordinate clause and disappeared as soon as participant spoke into the microphone. As the verb disappeared the subject and dative characters were displayed on the screen. The subject character was always on the left and the dative character was always on the right. The procedure for filler trials was the same except the emoticons were displayed in the position of the dative character. Participants were given 7000 ms to complete their response before the next trial began.

6.7.4 Coding

For each condition, responses were coded according to the language in which the determiner was presented. Responses were coded as determiners for definite articles (the; dem, der). If the determiner was spoken in the target language, the response was coded as 0. If the determiner was spoken in the non-target language, the response was coded as 1. All other responses were coded as NA and removed from data analysis for all other responses, including responding without a determiner, responding in the wrong language, and failing to respond at all. Results were discarded for participants who had a rate of other responses higher than 20% of all responses. Four participants were removed from data analysis because of the number of other responses they produced.

6.8 Results

The Hybrid model predicted that there would be more English determiners before German nouns than German determiners before English nouns. The MLF model predicted that there would be more English determiners before German nouns when switching from English to German. Again the results show that there were no instances of non-target language determiners in the one-language condition.

Table 18.

Experiment 6.2: German-English bilinguals' responses in dative NP production

Results						
Conditions				Responses		
Source Language	Target Language	Target Noun Gender	Language Condition	Target Language DET	Non-Target Language DET	NA
English	English	F	One-Language	153	0	7
English	English	M	One-Language	157	0	3
German	German	F	One-Language	154	0	6
German	German	M	One-Language	156	0	4
English	German	F	Two-Language	140	1	19
English	German	M	Two-Language	142	3	15
German	English	F	Two-Language	144	0	16
German	English	M	Two-Language	147	0	13

The results also show that there were very few instances in which the non-target determiner was used in the entire experiment; three times the English determiner was used before a German masculine dative noun, and once before a German feminine dative noun (see Table 18). Because of the very few instances of non-target language determiners the results are not expected to be significant. I will not report any statistical analysis because the descriptive statistics are sufficient to summarise the results.

6.9 Discussion

Experiment 6.2 explored an instance of English-German code-switching in which participants were instructed to code-switch before producing a dative NP. Our interest is similar to that of Experiment 6.1, however for German determiners in the dative case, masculine, feminine, and neuter determiners all change forms from the nominative case (i.e., *der* → *dem*, *die* → *der*, *das* → *dem*). In our experiment we only used masculine and feminine dative nouns. The Hybrid model predicted English determiners to accompany German nouns. This was not the case; the results ran counter to our predictions. It was shown that participants used the determiner consistent with the language of the target noun for almost every response. That is, the results showed that in the production of dative NPs, participants used as many English determiners before English nouns as they used German determiners before German nouns. The results also ran counter to the MLF model which predicted that because case-marking is a late outsider system morpheme, it can only come from the

ML. The results demonstrated that participants responded with case-marked determiners in the EL in nearly every code-switched trial.

6.10 General discussion

I reported two experiments investigating the way in which case-marking is processed during determiner selection. The Hybrid model assumes that case features are accessed in the same way as gender and number features: through a case feature node at the lemma level. Experiment 6.1 showed results that are consistent with MLF model. Though the Hybrid model made no explicit predictions for Experiment 6.1, the results were also consistent with a competition for selection account of determiner selection. The results from Experiment 6.2 did not support the Hybrid model predictions or the MLF model predictions, but can be explained by the competition for selection account of determiner selection.

It was anticipated that the results from Experiment 6.2 would show a similar pattern of determiner use as Experiment 6.1. In Experiment 6.1 the critical manipulation was forcing participants to code-switch before an accusative NP. The results of Experiment 6.1 showed participants used English determiners before German nouns and this effect was significant. For Experiment 6.2 the critical manipulation was forcing participants to code-switch before a dative NP. For German dative NPs all three genders change from the nominative form. We expected to see a similar number of English determiners used before German dative masculine and feminine nouns, but participants overwhelmingly used the appropriate German determiners.

Table 19.

Instances of determiners in Experiment 6.2

Determiner form	die	das	der	dem	the
Number of occurrences	32	32	125	84	273
Percentage of occurrences	5.9%	5.9%	22.9%	15.4%	50.0%

It is difficult to explain why the results from the two experiments contrast in the pattern of how the German determiners are used. When analysing the variation of determiners used in the stimuli materials, there is a case to be made that the results are consistent with the competitive account of determiner selection (see Table 19). When participants produced a dative NP, there is potential for competition between the English *the*, and the German *dem*, and *der*. Again, the English definite determiner

achieved the highest level of activation because it is the only definite determiner in English.

The German determiner *der* which is the form for the feminine dative determiner occurred the most frequently of all German determiners because it was the elicited response for feminine dative nouns but also because it shares its form with masculine nominative determiner: 4 of the 8 subject characters were German masculine nouns. The German masculine dative determiner *dem* had the second highest frequency of all German determiners, because it was the elicited response for masculine dative nouns and also because it occurred frequently within the subordinate clauses. The least frequent German determiners were *die*, and *das*: only 2 of 8 subject characters were of grammatical feminine gender and only 2 of 8 were of neuter gender. The distribution of determiners in the current experiment is not similar to the distribution of determiners used during natural language production (see Table 17). In the current experiment *dem* occurs with more frequency than *die* and *das* when compared with the distribution of determiners in natural language.

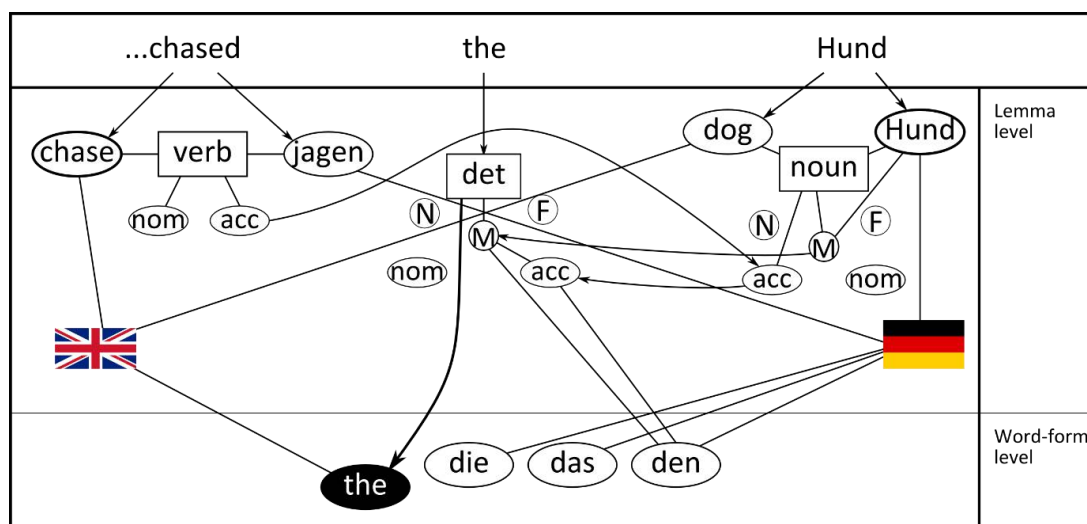


Figure 9. Selection of the English determiner within a German accusative NP. The top line represents the completion of the experimental sentence. The labels M, N, and F refer to the masculine, neuter, and feminine gender feature nodes respectively. The labels nom and acc refer to nominative and accusative case feature nodes respectively. The filled black oval represents the selection of the determiner.

I argued that in Experiment 6.1 it is possible that the trend showing that English determiners were produced instead of German masculine accusative determiners was because the German masculine accusative determiners appeared so

infrequently that they did not always achieve a high enough level of activation to become selected in favour of the English determiner. This is exemplified in Figure 9. The verb identifies the noun lemma *Hund* (dog) as accusative. The accusative case feature node and the masculine feature of the noun lemma sends activation to the determiner lemma. The German language node sends activation to the accusative determiner forms *die*, *das*, and *den*. The English language node sends activation to the determiner *the*. Because the German determiner *den* occurs with the least frequency of all determiners in Experiment 6.1, and because the English determiner *the* occurs with the highest frequency of all determiners in Experiment 6.1, the English determiner *the* becomes selected.

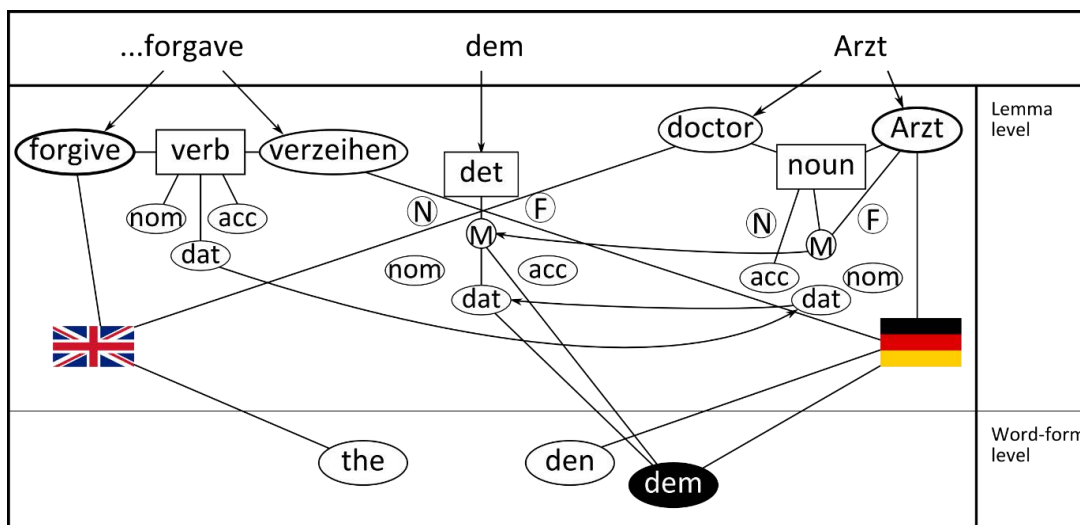


Figure 10. Selection of the German masculine dative determiner *dem* in the German dative NP. The top line represents the completion of the experimental sentence. The label *dat* represents the dative case feature node.

In Experiment 6.2 the form of the feminine dative determiner occurred the most frequently of all German determiners, and the masculine dative determiner occurred at the second highest frequency. The frequency of the dative determiners is considerably higher than the frequency of masculine accusative determiners in Experiment 6.1. Therefore it is reasonable to assume that in Experiment 6.2 the target German dative determiners achieved a high enough level of activation to become selected in favour of the English determiner. This is exemplified in Figure 10. The verb identifies the noun lemma *Arzt* (doctor) as dative. The dative feature case node and the masculine feature node of the noun lemma sends activation to the determiner lemma. The German language node sends activation to the German dative

determiner forms *den* and *dem*. The English language node sends activation to the English determiner *the*. Because *dem* occurs relatively frequently throughout the experimental session, it achieves a level of activation high enough to be selected.

Another line of research that can provide insight into the results of the current experiments is the recent work on planning scope and incrementality in language production. Planning scope refers to the amount of information that can be processed in parallel at a particular level of language production: in other words, how much of the production process is being prepared in advance. There are two views on how speakers plan and produce language. One view is that language production is word driven. That is, language production is driven by the syntactic information of words. Levelt et al. (1999), Pickering and Branigan (1998), and Hartsuiker and Pickering (2008) all describe a word-driven account of language production. According to the word driven view, concepts at the conceptual level activate relevant lemmas which in turn activate their syntactic properties. Once a lemma is selected its syntactic properties become available to build the structure of the sentence. For example, the selection of a transitive verb such as *kick* will tell the production process to select a noun for a direct object noun phrase. The selection of a dative verb such as *give* will tell the production process to select two nouns, one for the direct object noun phrase and one for the indirect object noun phrase.

The other view is that language production is structure driven. The structure driven view posits that the first step in the production process is to build an initial syntactic structure in which words can then be placed into their appropriate slots within the structure (Bock & Ferreira, 2014). Kuchinsky and Bock (2010) conducted an eye tracking experiment depicting events that were either easy or difficult to code. Participants were presented with a very brief visual cue prior to picture onset to force their attention towards a specific referent in the display. Only in hard to code events did the participants use the cued referent as agent; in easy to code events referent cueing had no effect on which referent became the agent. Kuchinsky and Bock argue that for easy to code events participants built an initial structure and then selected their agent to fit the structure. In Experiment 6.2 participants were presented with the verb at the beginning of each experimental trial which may cause the event to be easy to encode.

Konopka and Meyer (2014) found similar results in two language comprehension experiments that manipulated lexical priming, and structural priming. In the lexical priming experiment, Konopka and Meyer found that participants encoded accessible characters first and built syntactic structure what would place the accessible character in the subject position. In the structural prime experiment the use of first-fixated character as subject depended on the character's suitability as subject, ease of event encoding, and ease of constructing a sentence structure. The first fixated character was more likely to become the subject in easy to encode events than hard to encode events. The first fixated character was less likely to become the subject in primed structures than unprimed structures. In another two experiments manipulating easy of character encoding and ease of event encoding, van de Velde, Meyer, and Konopka, (2014) found similar results. Together these results show that there is no specific window for message planning, and planning scope changes from sentence to sentence depending on factors such as ease of character encoding and ease of event encoding. For easy to code events participants show a larger planning scope suggesting that they are building a structure for the available referents. For difficult to encode events participants generally choose the easy to encode character to fit in the subject position to help guide the building of the structure.

With planning scope and incrementality in mind, the nature of the experimental task could be responsible for the patterns of determiner use we observed in Experiment 6.2. Recall that participants were shown the infinitive form of a dative verb to be used in their sentence at the onset of the subordinate clause. It is possible that participants were able to expand their planning scope beyond the subordinate clause and subject NP based on the argument structure of the presented verb. The German dative verbs in the experiment were purposely chosen to allow for the option to drop the accusative object or dative preposition while keeping the dative case-marking on the determiner and noun. By presenting the participant with the dative verb early in sentence production it allowed them to plan a structure that fits the specific arguments of that verb. The early structure building means that grammatical function for the subject, indirect object, and the optional direct object NP or PP were already set, allowing participants to access case information as each segment of the message was produced. This has implications for the 4-M model and

the argument that case-marking requires information from outside of its head constituency to determine grammatical function. If speakers build syntactic structure in advance of lexical selection, it may be that case can be assigned as lemmas are accessed. This supports the Hybrid model view that case is accessed in the same way as other syntactic features and goes against the views of the 4-M model that case is accessed after lemmas are selected but when larger constituents are constructed.

If we consider the possibility that the experimental task in Experiment 6.2 allowed participants to use the presented verb to build an initial structure to construct their sentences, then let us consider the task used in Experiment 6.1. Experiment 6.1 used a similar paradigm, however instead of being presented with an infinitive verb, participants listened to pre-recorded sentence fragments that they were instructed to repeat. Rather than building a structure surrounding a presented verb like in Experiment 6.2, participants in Experiment 6.1 likely composed their utterances one word at a time. In other words, the task in Experiment 6.1 influenced participants to use a word-driven production processes whereas the task in Experiment 6.2 allowed participants to use a structure-driven process. In Chapter 2 I discussed the possibility that language production can follow both structurally and word-driven processes depending on which element of the message is encoded first: if a character in the sentence is encoded first then production follows a word-driven process and if the verb or event gist is encoded first then then production follows a structure-driven process.

6.11 Chapter summary

In this section I outlined two experiments I conducted to test whether determiners that depend on case features are accessed in the same way as gender and number features. The Hybrid model assumes that case features are accessed in the same manner as gender and number features, through connections to the head noun. Experiment 6.1 showed that there were more English determiners produced when switching from English to German than German determiners used when switching from German to English, and that there were English determiners used before German masculine nouns than before German feminine or neuter nouns. This result supported the predictions of the MLF model. The results can also be explained by the Hybrid model's competition for selection account of determiner selection.

Experiment 6.2 did not show the same pattern of results as Experiment 6.1: there were very few instances in which English determiners were paired with German nouns. Analysing the frequencies in which each determiner was used throughout each experimental session, the results show that instances in which English determiners were used with German nouns were when the target German determiner occurred the least frequently within the experimental session. I offer one final potential explanation for the different results between Experiments 6.1 and 6.2: because of the different tasks used in each experiment, the different tasks may have elicited different production processes. Namely, Experiment 6.1 elicited a word-driven approach whereas Experiment 6.2 elicited a structure-driven approach.

Chapter 7

Conclusions

7.0 Chapter overview

The purpose of this chapter is to summarise the results from my experiments and to discuss their implications on the predictions set by the Hybrid model. I begin this chapter by summarising the architecture and predictions of the Hybrid model. I will then very briefly discuss the MLF model and how it relates to the experiments reported in this thesis. I then discuss the results from my experiments starting with Experiment 3.1 on the word order of adjectives produced during code-switching between Spanish and English. I will then discuss Experiments 4.1 and 4.2 on the production of possessive pronoun agreement during code-switching between Spanish and English, and Experiments 5.1 and 5.2 on possessive determiner agreement during code-switching between French and English. I then discuss Experiments 6.1 and 6.2 and the production of case-marked determiners during code-switching between German and English. After discussing the implications of these findings and what they mean for the Hybrid model, I will then highlight aspects of the Hybrid model that requires further specification. Finally, I discuss possible directions for future research.

7.1 Aim of thesis

7.1.1 Hybrid model

The aim of the thesis was to propose and test a Hybrid model of bilingual language production. The lemma stratum of the Hybrid model is based on the Hartsuiker and Pickering (2008) model. At the lemma stratum lemmas are connected to their syntactic properties by a network of nodes. There are categorial nodes which connect to information on the category of word the lemma belongs to: nouns, verbs, adjectives, etc. There are featural nodes which connect to information on the type of features that belong to the lemma; grammatical gender, number, and definiteness for nouns and person, number, tense, and aspect for verbs. There are combinatorial

nodes which connect to information regarding the way in which the lemma combines with other linguistic units to form larger phrase structures, for example the verb *give* requires two arguments, a direct object and indirect object, and these two arguments can either take the DO or PO structure. For bilinguals, there is one final node, the language node, which connects lemmas to a language node for the language they belong to.

Similar to the Hartsuiker and Pickering (2008) model, the Hybrid model assumes that similar lexical items and syntactic structure between languages share representation within the lemma level. That is, lemmas from both languages connect to the same categorical, featural, and combinatorial nodes if the categorical, featural, and combinatorial information is shared between languages. The Hybrid model is a cascaded model which assumes that all activated lemmas at the lemma level send activation to the corresponding word-forms at the word-form level. The level of activation of word-forms at the word-form level influences lemma selection. The Hybrid model also assumes that lexical items in one language can be produced using the syntactic structure of the other language. In order to account for this, the Hybrid model assumes an architecture in which activated lemmas and their syntactic features feed activation down to the word-form level, and that this cascaded activation from the lemma level to the word-form level occurs between languages.

In order to test these assumptions of the Hybrid model, the experimental paradigm employed in this thesis was a forced code-switching task. In the forced code-switching task participants were required to produce sentences in one language, the source language, and switch to the other language, the target language, at a point in which the two participating languages may have different syntactic rules. The purpose of this experimental task was to see whether speakers would produce code-switched sentences in which the words in the target language use syntactic features from the source language.

7.1.2 MLF model

The main aim of the thesis was to test the proposed Hybrid model which was influenced by the MLF model and its ability to account for the production of open and closed class items. The experiments in this thesis were first and foremost

designed to test the Hybrid model but also aimed to test the MLF model. However, it became clear that the participant population and the experimental tasks may not have been suitable for testing the MLF model.

First, the MLF model is intended to account for bilingual speakers living in communities in which speaking both languages regularly, and most importantly code-switching regularly is the norm. In contrast, the participants in the experiments reported in this thesis were not asked about their code-switching habits. Language demographics were recorded from the participants and from this information it appears as though the majority of the participants did not use their second language with enough regularity to fall within the population of interest of the MLF model.

Second, the experimental methods used in this thesis were not suitable as a fair test of the MLF model. The experimental method used in this thesis was a forced code-switching task in which participants were given a specific place in a sentence to switch languages. The strength of the MLF model is that it was devised from natural code-switching data, and by forcing participants to switch languages at a specific point within a sentence takes this strength away. Because the MLF model is a model of natural code-switching we cannot use the findings from the experiments in this thesis to evaluate the MLF model. In addition to the experimental methods not being suitable, the experiments lacked the statistical power needed to test the intended interactions. Because of this, proper data analysis could not be conducted in order to test the predictions of the MLF model.

7.2 Summary of experimental findings and evaluating the Hybrid model

7.2.1 Word order

In Chapter 3 I reported an experiment which investigated how word order is processed when code-switching between languages that have different word orders for nouns and adjectives. In English adjectives are prenominal, and in Spanish adjectives are postnominal. In Experiment 3.1 participants were asked to code-switch prior to producing a noun phrase with an adjective. The findings showed that the native Spanish participants produced adjectives in the word order dictated by the target language. This does not support the predictions I set for the Hybrid model and

runs counter to the findings from Selles (2011). Selles (2011) found that Spanish speakers when code-switching from English to Spanish had a tendency to produce Spanish NPs with prenominal adjectives, though they did not produce English NPs with postnominal adjectives after switching from Spanish to English. However, if we consider the difference between the stimuli used in the current experiment and the stimuli used in Selles (2011), the pattern of results from the current experiment is explicable. In Selles (2011) participants were given the freedom to choose the adjective that they thought worked best for the pictures presented.

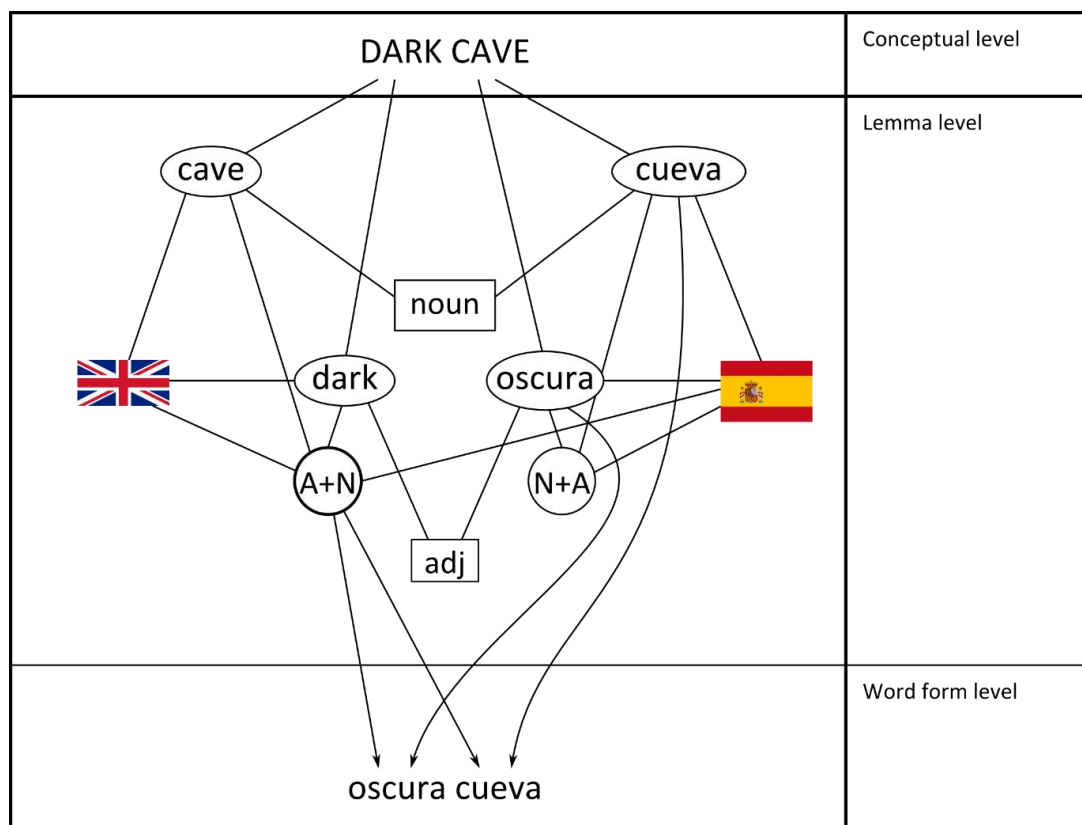


Figure 11. Production of *DARK CAVE* in Spanish using the English word order, in the Hybrid model. The Union flag represents the English language node and the Spanish flag represents the Spanish language node. Lines indicate connections between nodes. Note that speakers are given the choice to use any adjective; the Spanish language node therefore activates both noun+adjective combinatorial node (N+A) and the adjective+noun combinatorial node (A+N).

The freedom to choose any adjective to describe the picture meant that speakers could choose Spanish prenominal meaning-changing adjectives. With the possibility of using prenominal meaning-changing adjectives in Spanish NPs, the adjective+noun combinatorial node was activated when both English and Spanish

were active. Conversely, the noun+adjective combinatorial node was only activated when Spanish was active (see Figure 11). Note that in Figure 11 the language node is connected directly to the combinatorial nodes; this is different to what is assumed in Bernolet et al., (2007) in which the language nodes are only connected to the lemma nodes, and the lemma nodes connect to the combinatorial nodes. Because in Spanish the adjective *oscura* would not normally occur prenominally it would not be connected to the adjective+noun combinatorial node. I propose that the language node connects to the combinatorial nodes supported by that language: Spanish adjectives normally occur postnominally but also allows for prenominal meaning-changing adjectives. Because the language node is connected directly to the combinatorial node, Selles (2011) found Spanish speakers produced adjectives prenominally even if they were not meaning-changing adjectives (e.g., *oscura cueva*). Therefore, the additional activation of the adjective+noun combinatorial node from Spanish may have influenced the results.

In Experiment 3.1 of this thesis participants were limited to using colours as adjectives. Because colours as adjectives only occur postnominally in Spanish, the adjective+noun combinatorial node was only active when English was active. Again only the noun+adjective combinatorial node was active when Spanish was active because participants knew they only had to use colours as adjectives. Therefore, the current experiment saw a symmetrical pattern of activation of the word order combinatorial nodes, such that participants responded with the word order dictated by the target language (see Figure 12).

In Chapter 3 I proposed a mechanism in which the Hybrid model can explain the way in which speakers use meaning changing adjectives in Spanish. The adjective *viejo* (old) means old when used postnominally, but when used prenominally as in *viejo amigo* (old friend) it changes meaning to refer to a long-time friend rather than an elderly friend. Activation is sent down from the conceptual level to the appropriate combinatorial node. If the speaker means to use *viejo* to refer to age, then the concept of old at the conceptual level sends activation down to the noun+adjective combinatorial node. If the speaker means *viejo* as in long-time friend, then that concept at the conceptual level will send activation down the adjective+noun combinatorial node.

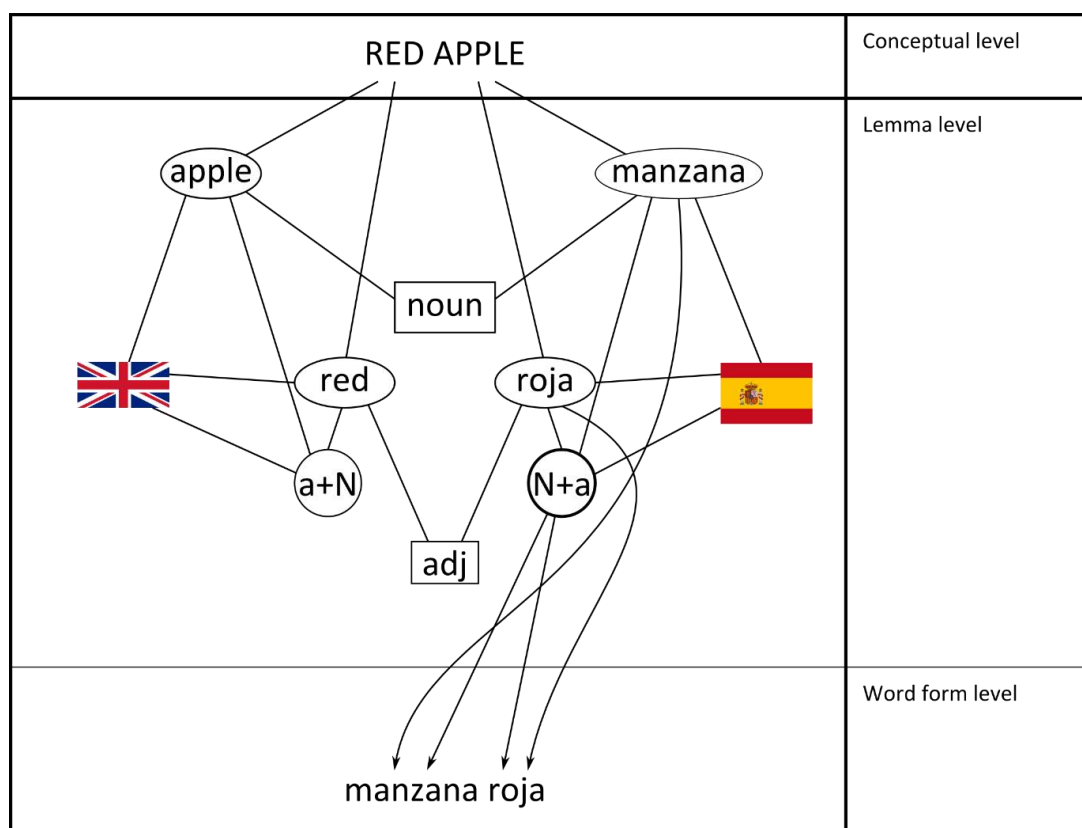


Figure 12. Production of *RED APPLE* in Spanish using the Spanish word order, in the Hybrid model. Note that speakers were instructed only to use colours as adjectives; hence Spanish activates only the noun+adjective combinatorial node.

7.2.2 Gender agreement of possessive pronouns

In Chapter 4 I reported Experiments 4.1 and 4.2 which investigated the way in which possessive pronouns are selected during code-switching between English and Spanish. Of particular interest is how bilinguals resolve agreement conflicts when code-switching between languages that have different agreement rules. In the two experiments I looked at the different agreement rules between English and Spanish: in English possessive pronouns agree with the possessor noun and in Spanish possessive pronouns agree with the possessed noun. In other words, English and Spanish have different controller nouns for possessive pronouns. In the experiments the participants had to code-switch prior to producing a possessive pronoun, and the genders of the English and Spanish controller nouns were either matched or mismatched.

In the code-switching conditions, when the genders of the controller nouns were mismatched both native English and native Spanish speakers responded with possessive pronouns that were inconsistent with the gender agreement of the target language. This pattern of inconsistent gender agreement responses did not depend on whether speakers switched from English to French or from French to English, and this effect did not occur with greater magnitude in the speakers' L2. However, Native English speakers demonstrated a higher number of incongruent gender agreement responses when the target language was Spanish and this difference was almost significant ($p < .055$). The pattern results from Experiments 4.1 and the combined analysis of Experiments 4.1 and 4.2 are consistent with the Hybrid model predictions.

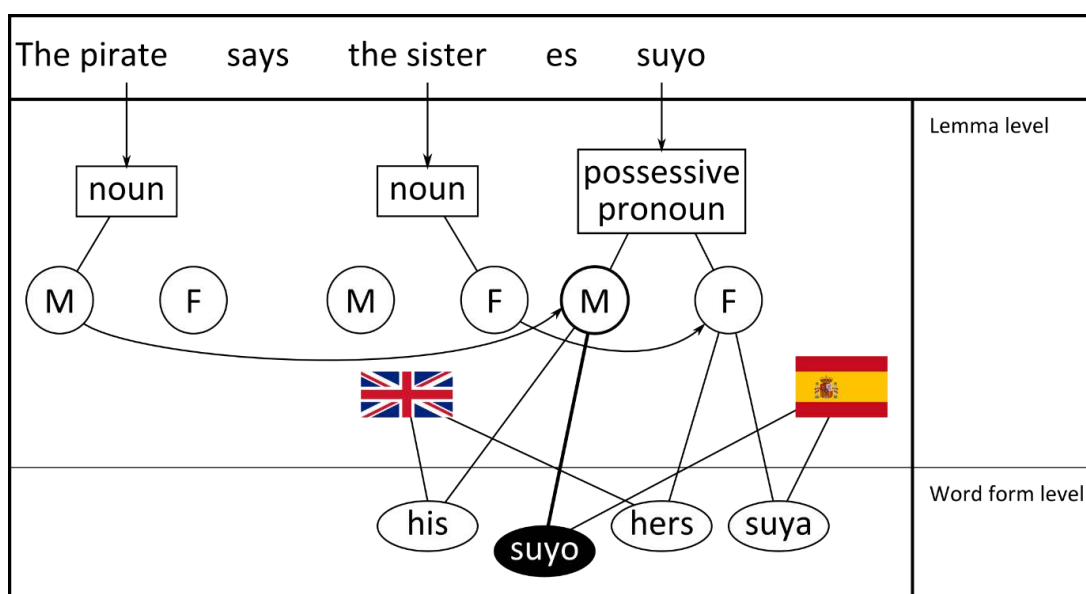


Figure 13. Production of an incongruent gender agreement response from Experiment 4.1, within the Hybrid model. The top line represents the completion of the experimental sentence. The English and Spanish lemmas representing *pirate* and *sister* are omitted for simplicity. The arrows represent the direction of spreading activation. The labels M and F refers to the masculine and feminine gender feature nodes respectively. The filled black oval represents the selection of the possessive pronoun.

The Hybrid model assumes that during bilingual speech, and more specifically during code-switching, the gender feature nodes of both controller nouns activate the gender feature nodes of the possessive pronoun. When both English and Spanish controller nouns are of matched genders, only one gender feature node sends activation to the possessive pronoun gender feature nodes. When the English and

Spanish controller nouns are of mismatched genders then both gender feature nodes send activation to the possessive pronoun gender feature nodes. In other words, in the mismatched gender condition both masculine and feminine feature nodes of the possessive pronoun lemma become activated. This process is exemplified in Figure 13. The noun lemma *pirate* activates the masculine feature node of the possessive pronoun in preparation for an English possessive pronoun, whereas the noun lemma *sister* activates the feminine feature node of the possessive pronoun in preparation for a Spanish possessive pronoun. Because the Hybrid model assumes that possessive pronoun selection occurs at the word-form level, the activated gender feature nodes of the possessive pronoun send cascading activation to the word-form level. At the word-form level all masculine and feminine possessive pronoun forms (i.e., *his*, *hers*, *suyo*, and *suya*) are activated and compete for selection. The possessive pronoun form that receives the highest level of activation is ultimately selected; in the example above the selected form is *suyo*, Spanish possessive determiner with gender agreement following the English rules.

7.2.3 Gender agreement of possessive determiners

In Chapter 5 I reported Experiments 5.1 and 5.2 which investigated the way in which possessive determiners are selected during code-switching between English and French. I investigated the same gender agreement issues as considered in Experiments 4.1 and 4.2. In English possessive determiners agree with the possessor noun and in French possessive determiners agree with the possessed noun, which means that English and French have different controller nouns for possessive determiners. The experimental design was similar as Experiments 4.1 and 4.2; participants were asked to code-switch prior to producing a possessive determiner, and the genders of the English and Spanish controller nouns were either matched or mismatched.

Experiment 5.1 and the combined analysis of Experiments 5.1 and 5.2 demonstrated a similar pattern as Experiment 4.1 and the combined analysis of Experiments 4.1 and 4.2. In the code-switching conditions inconsistent gender agreement responses occurred significantly more in the mismatch gender condition than in the match gender condition, and this pattern did not differ depending on

whether switching from English to French or from French to English. The pattern of results is consistent with the Hybrid model's predictions.

The Hybrid model assumes possessive pronouns and possessive determiners are selected in a similar manner. At the lemma level, the gender feature node of the controller noun activates the gender feature nodes of the possessive determiner. During code-switching between English and French, both the English and French controller nouns activate the gender feature node of the possessive determiner lemma. When the genders of both controller nouns match, then only one gender feature node of the possessive determiner lemma becomes activated. When the genders of both controller nouns are mismatched, then both gender feature nodes of the possessive determiner lemma become activated. This process is exemplified in Figure 14.

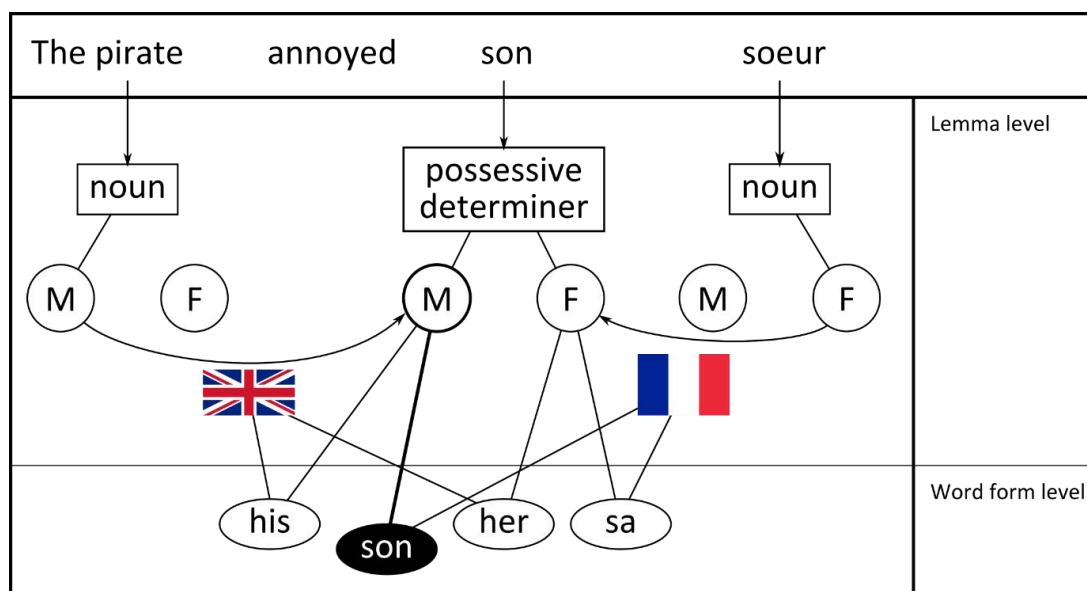


Figure 14. Production of an incongruent gender agreement response from Experiment 5.1, within the Hybrid model. The top line represents the completion of the experimental sentence. The English and French lemmas representing *pirate* and *soeur* are omitted for simplicity. The Union flag represents the English language node and the French flag represents the French language node. The arrows represent the direction of spreading activation. The labels M and F refers to the masculine and feminine gender feature nodes respectively. The filled black oval represents the selection of the possessive pronoun.

The *pirate* noun lemma activates the masculine feature node of the possessive determiner in preparation for an English possessive determiner. The *soeur* noun lemma activates the feminine feature node of the possessive determiner in

preparation for a Spanish possessive determiner. Both masculine and feminine feature nodes of the possessive determiner lemma are activated. Activation is then cascaded down to the word-form level, activating all four possessive determiner forms (i.e., *his*, *her*, *son*, and *sa*). All activated forms compete for selection, and it is the form that receives the highest level of activation that becomes selected. In our example, the form *son* receives the highest level of activation leading to an incongruent gender agreement response.

7.2.4 Case-marked determiners

In Chapter 6 I reported Experiments 6.1 and 6.2 that investigated the production of case-marked determiners in code-switching between English and German. The role of case during language production has been largely ignored, in particular when investigating determiner selection. With the Hybrid model I proposed that during determiner selection, case-marking is retrieved in a similar manner as grammatical gender and number; at the lemma level via links to featural nodes. I proposed that for languages with case systems, nouns have an additional featural node, the case node. Accusative nouns would activate the accusative case node which in turn activates the accusative case node of the determiner, in addition to the gender and number feature nodes.

In Experiment 6.1 I tested this proposal using native German speakers in a code-switching task in English and German. Accusative nouns were manipulated to be either masculine, feminine, or neuter nouns. In the accusative case, only masculine determiners have a different case-marking form from the default nominative form. By instructing participants to code-switch before an accusative noun, and by manipulating the gender of the accusative noun, I investigated whether speakers would use an equal number of German determiners as English determiners during the code-switching trials. The Hybrid model assumes determiner selection is a competition for selection process. However, I did not make any specific predictions in regards to how case would affect determiner selection.

It was found that in the code-switching trials, when switching from English to German participants produced more masculine accusative determiners in English than they produced feminine or neuter accusative determiners in English. I attributed

this pattern to be due to competition for selection and the fact that the English definite determiner had the highest frequency of use of all the determiners in the experiment, and the target German masculine accusative determiner had the lowest frequency of use. The relative frequency would cause the English definite determiner to have a higher relative activation in comparison to the German masculine accusative determiner, thus leading the English determiner to being selected instead of the German determiner.

In order to further test this, Experiment 6.2 was conducted using dative NPs. Dative NPs were used because the dative forms for masculine, feminine and neuter determiners are all different from their default nominative forms. Because masculine and neuter dative determiners have the same form, the experiment only tested masculine and feminine determiners. A similar code-switching paradigm was used in which participants were forced to code-switch before a dative NP. Because of the results from Experiment 6.1, namely that participants used more English determiners before German masculine accusative nouns than before German feminine or neuter nouns, I hypothesised that in Experiment 6.2 we should see English determiners used before German masculine and feminine dative nouns. It was hypothesized that because English determiners are used more frequently than the dative German determiners, the English determiners have a higher level of activation and would be selected.

The results showed that participants almost always responded with German dative determiners. The pattern went against my predictions and against the arguments made in support of a competition account of determiner selection to explain the results of Experiment 6.1. However, upon analysing the total number of different German determiners used throughout the experimental session the argument in favour of a competition for selection account remains valid. During the creation of the experimental items, the frequencies of the different determiners within the experimental items was not controlled. Of all the German determiners used in Experiment 6.2 (including the subordinate clause, the subject NP, and the dative NP), the feminine dative determiner occurred the most frequently and the masculine dative determiner occurred the second most frequently. Because the German dative determiners had a relatively high frequency of occurrence, it is possible that during

determiner selection they received enough activation to be selected instead of the English determiner. In Experiment 6.1 the masculine accusative determiner had the lowest frequency of use of all German determiners, which could explain why a number of English determiners were used in its place.

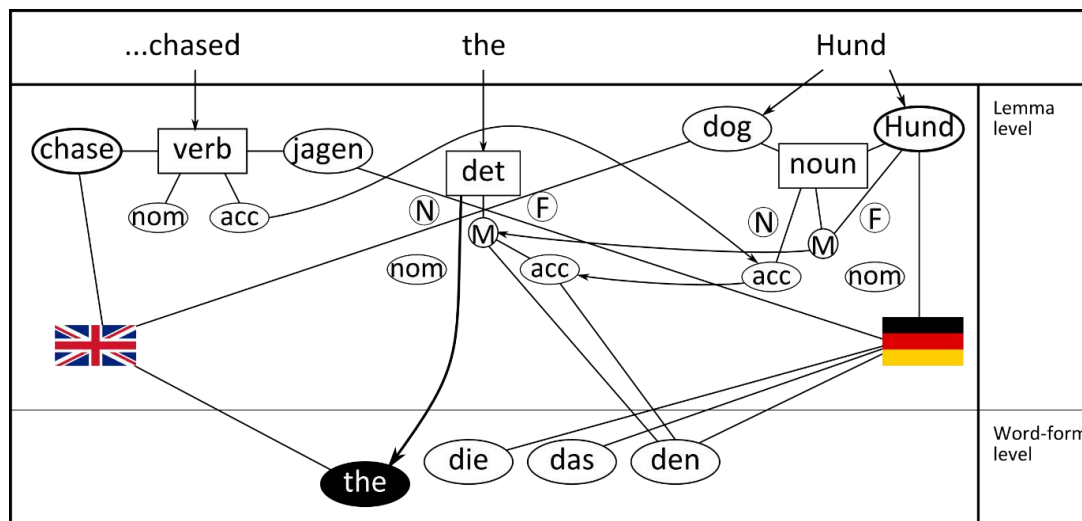


Figure 15. Selection of the English determiner within a German accusative NP, within the Hybrid model. The top line represents the completion of an experimental sentence in Experiment 6.1. The labels M, N, and F refer to the masculine, neuter, and feminine gender feature nodes respectively. The labels nom and acc refer to nominative and accusative case feature nodes respectively. The filled black oval represents the selection of the determiner.

The results of the experiment support a mechanism of determiner selection that includes a case feature node in addition to the gender and number feature nodes. For languages with case systems, nouns will activate the gender, number, and case feature nodes which then indirectly elect the appropriate determiner by activating the gender, number, and case feature nodes of the determiner lemma. The Hybrid model assumes determiner selection is a competitive process. During code-switching, the determiners for both languages are active and compete for selection. When only one of the participating languages has a case system as with Experiments 6.1 and 6.2, then only that language activates case feature nodes. Figure 15 demonstrates the process of selecting determiners when code-switching from English to German. The verb marks the *Hund* lemma as accusative. The masculine and accusative feature nodes from the *Hund* lemma activate the masculine and accusative feature nodes of the determiner lemma. Because determiners in English are limited in their form, the *dog* lemma only activates the determiner lemma. All activated features from the

determiner lemma sends cascading activation to the word-form level. At the word-form level all activated determiner forms compete for selection. In the example in Figure 15, the English determiner *the* becomes selected.

In addition to a competition for selection account, I also proposed that the difference between the observed patterns in Experiment 6.1 and 6.2 could be due to the difference in the experimental task. In Experiment 6.1 participants listened to a sentence fragment and were asked to complete the sentence by naming the picture presented which represented the missing accusative NP. In this task participants were not required to construct their own message, but rather repeat and complete the sentence. In Experiment 6.2 participants listened to a subordinate clause and were shown pictures representing the subject and dative nouns, and were visually presented with a verb. In this task participants had to create a message with the elements provided.

It is possible that the difference between the two experimental methods revealed a difference between word-driven and structure-driven production. During word-driven production it is the individual lemmas that build the sentence structure: nouns building NPs, verbs build VPs and recruit NPs via combinatorial nodes to satisfy the arguments of the verb (Cleland & Pickering, 2003; Pickering & Branigan, 1998). During structure-driven production, the event gist is encoded first to build an initial sentence structure and then characters are placed within that structure (Konopka & Meyer, 2014; Kuchinsky & Bock, 2010; van de Velde et al., 2014). I proposed that the task in Experiment 6.1 only required participants to select individual words, but in Experiment 6.2 participants had to form a message with the verb provided. Because in Experiment 6.2 participants were given the dative verb prior to constructing the message they were able to build an initial sentence structure that fit the arguments of the dative verb.

7.3 Hybrid model: Aspects needing further specification

7.3.1 Adjective word order

After data collection for Experiment 3.1 and after careful consideration, it appeared that the difference between the results of Experiment 3.1 and Selles (2011)

may have been due to the different adjectives participants were expected to use in each experiment. In Experiment 3.1 participants were restricted to using colours as adjectives whereas in Selles (2011) participants were allowed to use any adjective they felt best described the picture. A follow up experiment is necessary in order to determine the true cause of the discrepancy of the results. I propose an experiment in which every participants receives the same sentences and pictures, however one group of participants are given free choice of adjectives and the other group is restricted to only using colour. This between subject design would help determine whether the different results are in fact due to the difference in adjectives used throughout the experimental session.

In addition to a follow up experiment to clarify the differences between Experiment 3.1 and Selles (2011), further testing is required to determine whether the Hybrid model's architecture of node connectivity is accurate. As a brief summary, in addition to the adjective node, the Hybrid model proposes the language node is also attached to the adjectival word order combinatorial node. This proposed architecture of node connectivity explains how Selles (2011) found Spanish prenominal adjectives but Experiment 3.1 did not.

Furthermore, in section 3.5 and section 7.2.1 it was proposed that the Hybrid model could explain how speakers choose Spanish prenominal adjectives by a mechanism that sends activation from concepts at the conceptual level to the appropriate combinatorial node depending on whether the adjective requires pre- or postnominal position for its intended meaning. Further testing is required to determine whether this proposed mechanism works as described.

7.3.2 Conceptual and grammatical features

In Chapter 2 a speculated mechanism was discussed in which conceptual features at the conceptual level activate feature nodes at the lemma level. This mechanism would be responsible for selecting featural information for instances of agreement in which a controller noun has one conceptual feature but a different grammatical feature. An example of this would be the German noun *Mädchen* (girl). Conceptually *Mädchen* is feminine but grammatically it is neuter. As discussed briefly in Chapter 4, when pronouns are used at a short distance from its controller

noun the pronoun tends to agree with its grammatical features. At longer distances the pronoun tends to agree with the controller noun's conceptual features (Garnham et al., 1995; Meyer & Bock, 1999; Schweppe, 2013). With the speculated mechanism in which conceptual features activate features at the lemma level, I propose that grammatical features have a higher level of initial activation, but conceptual features have a longer residual activation. This could explain why grammatical features are selected at shorter distances and why conceptual features are selected at longer distances from the controller noun. The current experiments did not explore this possibility and this mechanism is purely speculative. Further research is required in order to determine the validity of this proposal.

7.3.3 Native language controller boost

Chapter 4 investigated gender agreement of possessive pronouns in English and Spanish. The raw data from Experiment 4.1 showed that the native English participants made more incongruent gender agreement responses when Spanish was the target language. This effect was not significant, but it was marginal ($p = .055$). Because of the relative low numbers of incongruent gender agreement responses in comparison to correct responses, this marginal effect cannot be attributed to the lack of knowledge of Spanish gender agreement rules. Therefore, I speculated that there may be a mechanism that acts as a boost towards the controller noun of the speaker's native language. This native language controller boost would send more activation to the native language controller noun than to the second language controller noun, and this increased activation would be modulated by proficiency in the second language. The more proficient a speaker is in their second language, the less of a boost they receive on the native language controller noun.

Perhaps more likely is that rather than a boost to the native language controller noun, the second language controller noun simply receives less activation. This effect would be modulated by second language proficiency. As the bilingual gains proficiency in their second language the second language controller noun receives more activation until it receives the same level of activation as the native language controller noun. Further testing is required to investigate the nature of this potential mechanism.

7.3.4 Further investigation of case-marking

Experiments 6.1 and 6.2 investigated the ways in which German accusative and dative case are assigned by verbs to nouns and determiners. The experiments were limited in the syntactic structures used for the experimental sentences, using a constant word order throughout. The experiments explored instances of case that rely on assignment from the verb. However, case may also rely on argument structure, prepositions, and meaning (Heinz & Matiassek, 1992). Additional experimentation is necessary to investigate how the different instances of case is assigned.

7.4 Directions for future research

In this section I discuss potential areas for future research that may strengthen support for the Hybrid model and may help clarify a number of findings from the experiments in this thesis.

7.4.1 Gender agreement

In this thesis, four experiments investigated how speakers resolved speaking in two languages with different gender agreement rules. It was found that speakers could speak in one language while using the gender agreement rules of the other language. For further study it would be interesting to investigate the way in which speakers would resolve conflicts of grammatical gender if the gender agreement rules were the same (i.e., with the same controller noun), but the translation equivalent of the controller noun is mismatching in gender. For example, the word for *desk* in Spanish is a masculine noun, *el escritorio*, but in Italian it is feminine, *la scrivania*. In an experiment similar to Experiments 4.1 and 4.2, we could elicit possessive pronouns in sentences in which the controller noun and its translation equivalent is either matched or mismatched in gender.

7.4.2 Case-marking

I conducted two experiments to investigate the way in which case-marking information is accessed for determiners. The two experiments did not control for the number and variation of different determiners in the stimuli materials. Specifically, it was the number and variation of determiners within the subordinate clauses of the experimental items that varied greatly from trial to trial (see Appendix D). A follow

up experiment in which the number of each German determiner is controlled to occur at similar frequency within the experimental items would provide a better analysis of whether the pattern of results was indeed a result of a competition for selection. In addition, the experimental tasks investigating the accusative case and the dative case were different which may also have contributed to the different pattern of results from each experiment. In Experiment 6.1, I elicited sentences with accusative NPs by having participants listen to incomplete sentences, repeat the sentence and complete the sentence by naming a picture that was displayed on the computer screen. In Experiment 6.2 I elicited dative NPs by showing participants pictures of two characters and a dative verb: participants constructed their own sentence from the materials provided. Another series of experiments that test the production of accusative and dative determiners with the same experimental task may be necessary to see whether the different results were due to the experimental tasks rather than the nature of language production.

7.5 Conclusion

In this thesis I set out to propose and test the Hybrid model of bilingual language production. Of particular interest is the architecture of the lemma stratum that allows for lexical items in one language to be produced in the syntactic structure of the other language. The hypothesized architecture assumes that all activated lemmas and their feature nodes send activation to the word-form level, and selection is a competitive process at the word-form level. In a series of experiments I have demonstrated that possessive pronouns and possessive determiners can be produced in one language while following the gender agreement rules of the other language offering support for the Hybrid model. I also found evidence to support a view of production in which languages with case systems treat case as a syntactic feature at the lemma level, similar to gender and number features. In sum, this thesis provides support for the Hybrid model, and provides a unique perspective on bilingual language production.

References

- Alario, F. X., & Caramazza, A. (2002). The production of determiners: Evidence from French. *Cognition*, 82(3), 179–223.
- Allen, C. (1997). Middle English case loss and the “creolization” hypothesis 1. *English Language and Linguistics*, 1(1), 63–89.
- Antón-Méndez, I. (2010). Gender Bender: Gender errors in L2 pronoun production. *Journal of Psycholinguistic Research*, 39(2), 119–139.
- Antón-Méndez, I. (2011). Whose? L2-English speakers’ possessive pronoun gender errors. *Bilingualism: Language and Cognition*, 14(3), 318–331.
- Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, 68(3), 255–278.
- Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48.
- Bergsleithner, J. M. (2011). The Role of Noticing and Working Memory Capacity in L2 Oral Performance. *Organon*, 26(51), 217–243.
- Berk-Seligson, S. (1986). Linguistic constraints on intrasentential code-switching : A study of Spanish/Hebrew bilingualism, 15, 313–348.
- Bernolet, S., Hartsuiker, R. J., & Pickering, M. J. (2007). Shared syntactic representations in bilinguals: Evidence for the role of word-order repetition. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, 33(5), 931–949.
- Bernolet, S., Hartsuiker, R. J., & Pickering, M. J. (2009). Persistence of emphasis in language production: A cross-linguistic approach. *Cognition*, 112(2), 300–317.
- Bierwisch, M., & Schreuder, R. (1992). From concepts to lexical items. *Cognition*, 42(1–3), 23–60.
- Bock, J. K., Butterfield, S., Cutler, A., Cutting, J. C., Eberhard, K. M., &

- Humphreys, K. R. (2006). Number agreement in British and American English: Disagreeing to agree collectively. *Language*, 82, 64–113.
- Bock, J. K., Eberhard, K. M., & Cutting, J. C. (2004). Producing number agreement: How pronouns equal verbs. *Journal of Memory and Language*, 51(2), 251–278.
- Bock, J. K., Eberhard, K. M., Cutting, J. C., Meyer, A. S., & Schriefers, H. (2001). Some attractions of verb agreement. *Cognitive Psychology*, 43, 83–128.
- Bock, J. K., & Ferreira, V. S. (2014). Syntactically Speaking. In M. Goldrick & V. S. Ferreira (Eds.), *The Oxford Handbook of Language Production* (pp. 21–46). New York, NY: Oxford University Press.
- Bock, J. K., Nicol, J. L., & Cutting, J. C. (1999). The ties that bind: Creating number agreement in speech. *Journal of Memory and Language*, 40, 330–346.
- Bordag, D., & Pechmann, T. (2008). Grammatical gender in speech production: Evidence from Czech. *Journal of Psycholinguistic Research*, 37(2), 69–85.
- Brown-Schmidt, S., & Konopka, A. E. (2008). Little houses and casas pequeñas: Message formulation and syntactic form in unscripted speech with speakers of English and Spanish. *Cognition*, 109(2), 274–280.
- Brown-Schmidt, S., & Konopka, A. E. (2015). Processes of incremental message planning during conversation. *Psychonomic Bulletin & Review*, 22(3), 833–843.
- Brown-Schmidt, S., & Tanenhaus, M. K. (2008). Real-Time Investigation of Referential Domains in Unscripted Conversation: A Targeted Language Game Approach. *Cognitive Science*, 32(4), 643–684.
- Buchmeier, M. (2009). German frequency list-1-5000 - Wiktionary. Retrieved March 3, 2018, from https://en.wiktionary.org/wiki/User:Matthias_Buchmeier/German_frequency_list-1-5000
- Cai, Z. G., Pickering, M. J., Yan, H., & Branigan, H. P. (2011). Lexical and syntactic representations in closely related languages: Evidence from Cantonese-Mandarin bilinguals. *Journal of Memory and Language*, 65(4), 431–445.

- Caramazza, A., & Miozzo, M. (1997). The relation between syntactic and phonological knowledge in lexical access: evidence from the 'tip-of-the-tongue' phenomenon. *Cognition*, 64(3), 309–343.
- Cleland, A. A., & Pickering, M. J. (2003). The use of lexical and syntactic information in language production: Evidence from the priming of noun-phrase structure. *Journal of Memory and Language*, 49(2), 214–230.
- Colomé, À. (2001). Lexical activation in bilinguals' speech production: Language-specific or language-independent? *Journal of Memory and Language*, 45, 721–736.
- Corbett, G. G. (1991). *Gender*. Cambridge, UK: Cambridge University Press.
- Costa, A., & Caramazza, A. (1999). Is lexical selection in bilingual speech production language-specific? Further evidence from Spanish-English and English-Spanish bilinguals, 2(3), 231–244.
- Costa, A., Kovacic, D., Fedorenko, E., & Caramazza, A. (2003). The gender congruency effect and the selection of freestanding and bound morphemes: Evidence from Croatian. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 29, 1270–1282.
- Costa, A., Santesteban, M., & Caño, A. (2005). On the facilitatory effects of cognate words in bilingual speech production. *Brain and Language*, 94(1), 94–103.
- Costa, A., Sebastián-Gallés, N., Miozzo, M., & Caramazza, A. (1999). The gender congruity effect: Evidence from Spanish and Catalan. *Language and Cognitive Processes*, 14(4), 381–391.
- Daneman, M., & Hannon, B. (2012). What do working memory span tasks like reading span really measure? In N. Osaka, R. H. Logie, & M. D'Esposito (Eds.), *The Cognitive Neuroscience of Working Memory* (pp. 21–42). Oxford, UK: Oxford University Press.
- De Bot, K. (2000). A bilingual production model: Levelt's "speaking" model adapted. In L. Wei (Ed.), *The bilingualism reader* (pp. 420–442). London, UK: Routledge.

- de Nicolás, I., & Robledo, J. (2017). *Adjective Placement in Spanish and Basque Mixed DPs. Bilingualism Research Laboratory Gala 13*. Chicago, IL.
- Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review*, 93(3), 283–321.
- Dell, G. S., Nozari, N., & Oppenheim, G. M. (2014). Word Production: Behavioral and Computational Considerations. In *The Oxford Handbook of Language Production* (pp. 88–104).
- Dell, G. S., & Reich, P. A. (1981). Stages in sentence production: An analysis of speech error data. *Journal of Verbal Learning and Verbal Behavior*, 20(6), 611–629.
- Dell, G. S., Schwartz, M. F., Martin, N., Saffran, E. M., & Gagnon, D. A. (1996). A connectionist model of naming errors in aphasia. In J. Reggia, R. Berndt, & E. Ruppin (Eds.), *Neural modelling of cognitive and brain disorders* (pp. 135–156). New York, NY, NY: World Scientific.
- Dhooge, E., De Baene, W., & Hartsuiker, R. J. (2016). The mechanisms of determiner selection and its relation to lexical selection: An ERP study. *Journal of Memory and Language*, 88, 28–38.
- Eberhard, K. M., Cutting, J. C., & Bock, J. K. (2005). Making syntax of sense: number agreement in sentence production. *Psychological Review*, 112(3), 531–559.
- Engle, R. W. (2001). What is working memory capacity? In H. L. Roediger, J. S. Nairne, I. Neath, & A. M. Seprenant (Eds.), *The nature of remembering: Essays in honor of Robert G. Crowder* (pp. 297–314). Washington, DC: American Psychological Association Press.
- Franck, J. (2011). Reaching agreement as a core syntactic process: Commentary of Bock and Middleton Reaching Agreement. *Natural Language and Linguistic Theory*, 29(4), 1071–1086.
- Garnham, A., Oakhill, M. F., Ehrlich, M., & Carreiras, M. (1995). Representations and processes in the interpretation of pronouns: New evidence from Spanish and

- French. *Journal of Memory and Language*, 34(1), 41–62.
- Garrett, M. F. (1975). Syntactic processing in sentence production. In G. H. Bower (Ed.), *The Psychology of Learning and Motivation: Advances in Research and Theory* (9th ed., pp. 133–177). New York, NY: Academic Press.
- Garrett, M. F. (1980). Levels of processing in sentence production. In B. Butterworth (Ed.), *Language production* (pp. 177–220). London, UK: Academic Press.
- Garrett, M. F. (1982). Production of speech: Observations from normal and pathological language use. In A. W. Ellis (Ed.), *Normality and Pathology in Cognitive Functions* (pp. 19–76). London, UK: Academic Press.
- Garrett, M. F. (1988). Processes in language production. In F. J. Newmeyer (Ed.), *Linguistics: The Cambridge survey, III: Language: Psychological and biological aspects* (pp. 69–96). Cambridge, UK: Cambridge University Press.
- Garrett, M. F. (1990). Sentence processing. In D. N. Osherson & H. Lasnik (Eds.), *Language: An invitation to cognitive science* (Vol. 1, pp. 133–175). Cambridge, MA: The MIT Press.
- Gingrás, R. (1974). Problems in the description of Spanish/English intrasentential code-switching. In G. Bills (Ed.), *Southwest areal linguistics* (pp. 167–174). San Diego, CA: University of California at San Diego, Institute for Cultural Pluralism.
- Gleitman, L. R., January, D., Nappa, R., & Trueswell, J. C. (2007). On the give and take between event apprehension and utterance formulation. *Journal of Memory and Language*, 57(4), 544–569.
- Griffin, Z. M., & Bock, J. K. (1998). Constraint, Word Frequency, and the Relationship between Lexical Processing Levels in Spoken Word Production. *Journal of Memory and Language*, 38(3), 313–338.
- Gumperz, J. J. (1976). The sociolinguistic significance of conversational code-switching. In J. Cook-Gumperz & J. J. Gumperz (Eds.), *Papers on Language and Context* (pp. 1–46). Berkeley, CA.

- Gumperz, J. J., & Hernández-Chávez, E. (1975). Cognitive Aspects of Bilingual Communication. In E. Hernández-Chávez, A. D. Cohen, & A. F. Beltramo (Eds.), *El lenguaje de los chicanos: Regional and Social Characteristics of Language used by Mexican Americans* (pp. 154–163). Arlington, VA: Center for Applied Linguistics.
- Harley, T. A. (1993). Phonological activation of semantic competitors during lexical access in speech production. *Language and Cognitive Processes*, 8(3), 291–309.
- Hartsuiker, R. J., & Pickering, M. J. (2008). Language integration in bilingual sentence production. *Acta Psychologica*, 128(3), 479–489.
- Hartsuiker, R. J., Pickering, M. J., & Veltkamp, E. (2004). Is syntax separate or shared between languages? *Psychological Science*, 15(6), 409–414.
- Hatzidaki, A., Branigan, H. P., & Pickering, M. J. (2011). Co-activation of syntax in bilingual language production. *Cognitive Psychology*, 62(2), 123–150.
- Heinz, W., & Matiassek, J. (1992). *Argument Structure and Case Assignment in German*. Vienna, Austria.
- Horton, W. S., & Keysar, B. (1996). When do speakers take into account common ground? *Cognition*, 59(1), 91–117.
- Jaeger, T. F. (2008). NIH Public Access. *Journal of Memory and Language*, 59(4), 434–446.
- Janssen, N., Schiller, N. O., & Alario, F. X. (2014). The selection of closed-class elements during language production: A reassessment of the evidence and a new look on new data. *Language and Cognitive Processes*, 29(6), 695–708.
- Jescheniak, J. D., Schriefers, H., & Lemhöfer, K. (2012). What data from the simple-picture naming task tell us about lexical competition—A rejoinder to Janssen, Schiller, and Alario. *Language, Cognition and Neuroscience*, 29(6), 709–713.
- Jescheniak, J. D., Schriefers, H., & Lemhöfer, K. (2014). Selection of freestanding and bound gender-marking morphemes in speech production: a review. *Language, Cognition and Neuroscience*, 29(6), 684–694.

- Kantola, L., & van Gompel, R. P. G. (2011). Between- and within-language priming is the same: evidence for shared bilingual syntactic representations. *Memory & Cognition*, 39(2), 276–290.
- Kempen, G., & Hoenkamp, E. (1987). An Incremental Procedural Grammar for Sentence Formulation. *Cognitive Science*, 258, 201–258.
- Kempen, G., & Huijbers, P. (1983). The lexicalization process in sentence production and naming: indirect election of words. *Cognition*, 14(2), 185–209.
- Konopka, A. E. (2012). Planning ahead: How recent experience with structures and words changes the scope of linguistic planning. *Journal of Memory and Language*, 66(1), 143–162.
- Konopka, A. E., & Brown-Schmidt, S. (2014). *Message encoding. The Oxford Handbook of Language Production*.
- Konopka, A. E., & Meyer, A. S. (2014). Priming sentence planning. *Cognitive Psychology*, 73, 1–40.
- Kootstra, G. J., van Hell, J. G., & Dijkstra, T. (2010). Syntactic alignment and shared word order in code-switched sentence production: Evidence from bilingual monologue and dialogue. *Journal of Memory and Language*, 63(2), 210–231.
- Kootstra, G. J., Van Hell, J. G., & Dijkstra, T. (2012). Priming of code-switches in sentences: The role of lexical repetition, cognates, and language proficiency. *Bilingualism: Language and Cognition*, 15(4), 797–819.
- Kroeger, P. R. (2005). *Analyzing Grammar: An Introduction*. Cambridge, UK: Cambridge University Press.
- Kuchinsky, S. E., & Bock, J. K. (2010). *From Seeing To Saying: Perceiving, Planning, Producing*. New York, NY.
- La Heij, W., Mak, P., Sander, J., & Willeboordse, E. (1998). The gender-congruency effect in picture-word tasks. *Psychological Research*, 61, 201–219.
- Lance, D. M. (1975). Spanish-English code-switching. In E. Hernandez-Cheves & A. Beltramo (Eds.), *El lenguaje de los chicanos* (pp. 138–153). Arlington, VA:

Center for Applied Linguistics.

- Lemhöfer, K., Schriefers, H., & Jescheniak, J. D. (2006). The processing of free and bound gender-marked morphemes in speech production: Evidence from Dutch. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32(2), 437–442.
- Levelt, W. J. M. (1989). *Speaking: From Intention to Articulation*. (W. J. M. Levelt, Ed.). Cambridge, MA: MIT Press.
- Levelt, W. J. M. (2001). Spoken word production: A theory of lexical access in speech production. In *Proceedings of the National Academy of Sciences* (pp. 13464–13471).
- Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, 22(1), 1–75.
- Levelt, W. J. M., Schriefers, H., Vorberg, D., Meyer, A. S., Pechmann, T., & Havinga, J. (1991). The time course of lexical access in speech production: A study of picture naming. *Psychological Review*, 98(1), 122–142.
- Linck, J. A., Osthus, P., Koeth, J. T., & Bunting, M. F. (2014). Working memory and second language comprehension and production: A meta-analysis. *Psychonomic Bulletin & Review*, 21(4), 861–883.
- Lipski, J. M. (1978). Code-switching and the problem of bilingual competence. In *Aspects of bilingualism* (pp. 250–264).
- Loebell, H., & Bock, J. K. (2003). Structural priming across languages. *Linguistics*, 41(5), 791–824.
- Mahowald, K., James, A., Futrell, R., & Gibson, E. (2016). A meta-analysis of syntactic priming in language production. *Journal of Memory and Language*, 91, 5–27.
- McClure, E. (1977). Aspects of code-switching in the discourse of bilingual Mexican-American children. *Georgetown University Round Table on Languages and Linguistics*, 93–115.

- McClure, E. (1981). Formal and functional aspects of the codeswitched discourse of bilingual children. In R. P. Duran (Ed.), *Latino Language and Communicative Behavior* (pp. 69–94). Norwood, NJ: Ablex.
- Meijer, P. J. A., & Fox Tree, J. E. (2003). Building Syntactic Structures in Speaking: A Bilingual Exploration. *Experimental Psychology*, 50(3), 184–195.
- Melinger, A., & Dobel, C. (2005). Lexically-driven syntactic priming. *Cognition*, 98(1), 11–20.
- Meyer, A. S., & Bock, J. K. (1999). Representations and Processes in the Production of Pronouns : Some Perspectives from Dutch. *Journal of Memory and Language*, 41, 281–301.
- Michael, E. B., & Gollan, T. H. (2005). Being and becoming bilingual: Individual differences and consequences for language production. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 389–407). New York, NY: Oxford University Press.
- Miozzo, M., & Caramazza, A. (1997). Retrieval of lexical-syntactic features in tip-of-the-tongue states. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, 23(6), 1410–1423.
- Miozzo, M., & Caramazza, A. (1999). The Selection of Determiners in Noun Phrase Production, 25(4), 907–922.
- Myers-Scotton, C. (1993). *Duelling Languages: Grammatical Structure in Codeswitching*. Oxford, UK: Clarendon Press.
- Myers-Scotton, C. (1997). *Duelling Languages: Grammatical Structure in Codeswitching*. Oxford, UK: Clarendon Press.
- Myers-Scotton, C. (2002). *Contact Linguistics: Bilingual Encounters and Grammatical Outcomes*. Oxford, UK: Oxford University Press.
- Myers-Scotton, C. (2006). Natural codeswitching knocks on the laboratory door. *Bilingualism: Language and Cognition*, 9(2), 203–212.
- Myers-Scotton, C., & Jake, J. L. (1995). Matching lemmas in a bilingual language

- competence and production model: evidence from intrasentential code switching. *Linguistics*, 33(5), 981–1025.
- Myers-Scotton, C., & Jake, J. L. (2000a). Four types of morpheme: evidence from aphasia, code switching, and second-language acquisition. *Linguistics*, 38(6), 1053–1100.
- Myers-Scotton, C., & Jake, J. L. (2000b). Testing the 4-M model: An introduction. *International Journal of Bilingualism*, 4(1), 1–8.
- Myers-Scotton, C., & Jake, J. L. (2001). Explaining aspects of code-switching and their implications. In J. L. Nicol (Ed.), *One Mind, Two Languages: Bilingual Language Processing* (pp. 84–116). Malden, MA: Blackwell Publishers.
- Myers-Scotton, C., & Jake, J. L. (2014). Nonfinite verbs and negotiating bilingualism in codeswitching: Implications for a language production model. *Bilingualism: Language and Cognition*, 17(3), 511–525.
- Myers-Scotton, C., & Jake, J. L. (2016). Revisiting the 4-M model: Codeswitching and morpheme election at the abstract level. *International Journal of Bilingualism*, (February), 1–27.
- Namba, K. (2002). An overview of Myers-Scotton's Matrix Language Frame model. *Tokai University Shimizu Wwww Sisf*, 1–10.
- Navarrete, E., & Costa, A. (2009). The naming of gender-marked pronouns supports interactivity in models of lexical access. *Sciences-New York*, 301–321.
- Osborne, T. (2008). Major constituents and two dependency grammar constraints on sharing in coordination *, 6, 1109–1165.
- Peterson, R. R., & Savoy, P. (1998). Lexical selection and phonological encoding during language production: Evidence for cascaded processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24(3), 539–557.
- Pfaff, C. W. (1976). Functional and structural constraints on syntactic variation in code-switching. In B. Steever (Ed.), *Papers from the Para session on diachronic syntax* (pp. 248–259). Chicago, IL: Chicago Linguistic Society.

- Pickering, M. J., & Branigan, H. P. (1998). The Representation of Verbs: Evidence from Syntactic Priming in Language Production. *Journal of Memory and Language*, 39(4), 633–651.
- Pickering, M. J., & Ferreira, V. S. (2008). Structural Priming: A Critical Review. *Psychological Bulletin*, 134(3), 427–459.
- Poplack, S. (1980). Sometimes I'll start a sentence in Spanish. *Linguistics*, 18(7), 581–618.
- Poplack, S. (1981). Syntactic structure and social function of code-switching. *Latino Language and Communicative Behavior*, 169–184.
- Preziosa-Di Quinzio, I. (1992). *Teoreticamente la firma fa indietro. Frammistione di italiano e Schwyzertütsch nella conversazione di figli di emigrati*.
- Rapp, B., & Goldrick, M. (2000). Discreteness and interactivity in spoken word production. *Psychological Review*, 107(3), 460–499.
- Roelofs, A., Meyer, A. S., & Levelt, W. J. M. (1996). Interaction between semantic and orthographic factors in conceptually driven naming: Comment on Starreveld and La Heij (1995). *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22, 246–251.
- Sachs, J. (1974). Memory in reading and listening to discourse. *Memory & Cognition*, 2, 95–100.
- Salamoura, A., & Williams, J. N. (2006). Lexical activation of cross-language syntactic priming. *Bilingualism*, 9(3), 299–307.
- Salamoura, A., & Williams, J. N. (2007). Processing verb argument structure across languages: Evidence for shared representations in the bilingual lexicon. *Applied Psycholinguistics*, 28(4), 627–660.
- Schiller, N. O., & Caramazza, A. (2003). Memory and language grammatical feature selection in noun phrase production: Evidence from German and Dutch. *Journal of Memory and Language*, 48, 169–194.
- Schmitt, B. M., Meyer, A. S., & Levelt, W. J. M. (1999). Lexical access in the

- production of pronouns. *Cognition*, 69(3), 313–35.
- Schoonbaert, S., Hartsuiker, R. J., & Pickering, M. J. (2007). The representation of lexical and syntactic information in bilinguals: Evidence from syntactic priming. *Journal of Memory and Language*, 56(2), 153–171.
- Schriefers, H. (1993). Syntactic Processes in the Production of Noun Phrases, 19(4), 841–850.
- Schriefers, H., Hantsch, A., & Jescheniak, J. D. (2002). Determiner selection in noun phrase production. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 28(5), 941–950.
- Schriefers, H., Jescheniak, J. D., & Hantsch, A. (2005). Selection of gender-marked morphemes in speech production. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 159–168.
- Schriefers, H., Meyer, A. S., & Levelt, W. J. M. (1990). Exploring the time course of lexical access in language production: Picture-word interference studies. *Journal of Memory and Language*, 29(1), 86–102.
- Schriefers, H., & Teruel, E. (2000). Grammatical gender in noun phrase production: the gender interference effect in German. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26(6), 1368–1377.
- Schweppe, J. (2013). Distance Effects in Number Agreement. *Discourse Processes*, 50(8), 531–556.
- Selles, A. (2011). *Cross-linguistic interference in the production of adjective and noun word order by Spanish-English bilinguals*. University of Edinburgh.
- Slobin, D. I. (1996). From “thought and language” to “thinking for speaking.” In S. Gumperz, J. Levinson (Ed.), *Rethinking Linguistic Relativity* (pp. 70–96). Cambridge, UK: Cambridge University Press.
- Starreveld, P. a., & La Heij, W. (1995). Semantic interference, orthographic facilitation, and their interaction in naming tasks. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21(3), 686–698.

- Tomlin, R. (1997). Mapping conceptual representations into linguistic representations: the role of attention in grammar. In E. Noyts, J. Rederson (Ed.), *With Language in Mind* (pp. 162–189). Cambridge, UK: Cambridge University Press.
- van Berkum, J. J. A. (1997). Syntactic processes in speech production: The retrieval of grammatical gender. *Cognition*, 64(2), 115–152.
- van de Velde, M., Meyer, A. S., & Konopka, A. E. (2014). Message formulation and structural assembly: Describing “easy” and “hard” events with preferred and dispreferred syntactic structures. *Journal of Memory and Language*, 71(1), 124–144.
- Veldés-Fallis, G. (1978). *Code-switching and the Classroom Teacher*. Arlington, VA: Center for Applied Linguistics.
- Vigliocco, G., Antonini, T., & Garrett, M. F. (1997). Grammatical gender is on the tip of Italian tongues. *Psychological Science*, 8(4), 314–317.

Appendices

A. Appendix for Chapter 3

A.1 Experimental materials for Experiment 3.1

The sentences below are the experimental sentences presented in Experiment 3.1.

The sentence fragment on the left is what was displayed for participants to repeat.

The completion on the right is how the participants were expected to complete the sentence by naming the picture presented with the sentence fragment. The sentences below are from the English-English version.

The driver accelerates the	red car
The girl folds the	orange shirt
The student recycles the	yellow notebook
The dog chases the	green ball
The swimmer grabs the	blue towel
The maid cleans the	purple sheets
The boy rips the	brown trousers
The kid throws the	grey rocks
The cleaner hangs the	white blouse
The witch strokes the	black cat
The woman wears the	red dress
The girl won the	orange bicycle
The child eats the	yellow apple
The chef fries the	green tomatoes
The girl looks at the	blue sky
The judge awards the	purple ribbon
The boy finds the	brown dog
The wind blows the	grey clouds
The zoologist tames the	white lion
The cowboy tosses the	black hat
The husband buys the	red shoes
The timekeeper uses the	orange watch
The boy breaks the	yellow pencil
The mongoose scared the	green snake
The referee uses the	blue whistle
The lady washes the	purple skirt
The salesman opens the	brown door
The wizard wears the	blue robe
The model buys the	white dress
The knight draws the	black sword
The architect snaps the	red ruler
The gardener picks the	orange flower
The carpenter sharpens the	yellow chisel
The lawyer stains the	green tie
The boy hangs the	blue sweater

The girl drinks the	purple soda
The couple sells the	brown sofa
The child likes the	grey elephant
The man builds the	white fence
The girl reads the	black book
The boy picks the	red socks
The potter made the	orange mug
The trucker reads the	yellow sign
The caretaker waters the	green grass
The cat chases the	blue bird
The mother knits the	purple scarf
The clown forgets the	white gloves
The technician throws the	black phone

The sentences below are from the Spanish-Spanish version and are translation equivalents of the English-English version.

El conductor aceleró el	auto rojo
La niña dobla la	camisa naranja
El estudiante recicla el	cuaderno amarillo
El perro presigue el	balon verde
El nadador coge la	toalla azul
La sirvienta limpia las	sabanas moradas
El niño rasga los	pantalones marrones
El niño tira los	piedras grises
El limpiador cuelga la	blusa blanca
la bruja acaricia el	gato negro
La mujer viste un	vestido rojo
La niña ganó la	bicicleta naranja
El niño come la	manzana amarilla
El chef prepara los	tomates verdes
La niña mira el	cielo azul
La jueza concede la	cinta morada
El niño encuentra el	perro marrón
El viento sopla las	nubes grises
El domador doma el	león blanco
El vaquero lanza el	sombrero negro
El marido compra las	zapatos rojas
El cronometrador usa el	reloj naranja
El niño rompe el	lápiz amarillo
La mangosta asustó a la	serpiente verde
El árbitro utiliza el	pito azul
La mujer se lave la	falda morada
El vendedor se abra la	puerta marrón
El mago viste la	capa azul
La modelo compra el	vestido blanco
El caballero desenvainó la	espada negro
El arquitecto rompe la	regla roja

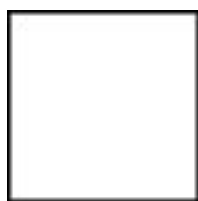
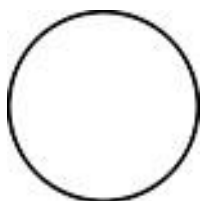
El jardinero coge la	flor naranja
El carpintero afila el	cincel amarillo
El abogado mancha la	corbata verde
El muchacho se cuelga el	chaleco azul
La muchacha bebe la	bebida púrpura
La pareja se venda el	sofá marrón
Al niño le gusta el	elefante gris
El hombre construye la	cerca blanca
La niña lee el	libro negro
El niño recoge los	soquetes rojos
El ceramista hizo la	taza naranja
El camionero lee el	signo amarillo
El cuidador riega el	césped verde
El gato presigue al	pájaro azul
La madre teje la	bufanda morada
El payaso se olvida los	guantes blancos
El técnico tira el	teléfono negro

The following pictures are the pictures paired with the sentence fragments to elicit completions:





The pictures were either presented within a square border for same language completions or within a circular border to elicit completions in the other language.



B. Appendix for Chapter 4

B.1 Experimental materials for Experiments 4.1 and 4.2

In Experiments 4.1 and 4.2, sentences were elicited with the presentation of two characters, one serving as subject (subject characters) and the other as object (family member characters) of the sentence along with a written verb. The following pictures are the subject characters: ballerina, boxer, doctor, nurse, pirate, sailor, waitress, and witch.



The following pictures are of the family member characters: aunt, brother, daughter, father, mother, sister, son, uncle.



The following verbs were presented randomly within each subject-family member pairing:

English verbs
acknowledges
admits
answers
assumes
believes
concludes
confirms
guesses
hopes
imagines
infers
judges

Spanish verbs
reconoce
admite
responde
asume
cree
concluye
confirma
adivina
espera
imagina
infiere
juzga

predicts
says
speculates
thinks

predice
dice
especula
piensa

C. Appendix for Chapter 5

C.1 Experimental material for Experiments 5.1 and 5.2

In Experiments 5.1 and 5.2 participants listened to a subordinate clause, and were shown pictures two characters, one representing the subject (subject characters) and one representing the object of the sentence (family member characters). The infinitive form of a verb was visually presented at the same time as the pictures. The subject characters and family member characters are identical to those of Experiments 4.1 and 4.2. The following sentence fragments are the aurally presented subordinate clauses:

English subordinate clauses	French subordinate clauses
Last winter	Mercredi dernier
Last Wednesday	Le mois dernier
Last Thursday	L'hiver dernier
Last Sunday	L'automne dernier,
Before breakfast	Mardi dernier
Before bed	Au printemps dernier,
Last Saturday	Vendredi dernier
Earlier today	Jeudi dernier
Last autumn	Dimanche dernier
In the evening	La semaine dernière
Before dinner	L'été dernier,
Last month	Dans le matin
Before lunch	La nuit dernière
Last year	L'année dernière
Last spring	Samedi dernier
Last Tuesday	Lundi dernier
Last Monday	L'été dernier,
Last Friday	Mercredi dernier
Last Wednesday	Avant de se coucher
Last Sunday	Dans l'après-midi
Last autumn	Au printemps dernier,
Before lunch	Lundi dernier
Before breakfast	Avant le déjeuner,
Earlier today	Avant midi
Last Saturday	Plus tôt aujourd'hui,
Last year	Avant le petit déjeuner
In the evening	Dimanche dernier
Before dinner	La semaine dernière
Before dinner	Dans la soirée
Last week	L'année dernière

Before noon
Last week

La semaine dernière
La nuit dernière

The following verbs were presented randomly within each subject-family member pairing:

English verbs

abandon
adore
alert
amuse
anger
annoy
call
compliment
confuse
criticize
defend
dissappoint
doubt
embarrass
entertain
envy
greet
hug
ignore
lecture
like
message
pamper
persuade
praise
reward
scare
see
surprise
visit
welcome
worry

French verbs

abandonner
adorer
alerter
amuser
irriter
ennuyer
appeler
complimenter
embrouiller
critiquer
défendre
décevoir
douter
embarrasser
divertir
envier
saluer
embrasser
ignorer
réprimander
aimer
notifier
choyer
persuader
vanter
recompenser
effrayer
voir
surprendre
visiter
accueillir
inquiéter

D. Appendices for Chapter 6

D.1 Experimental material for Experiment 6.1

In Experiment 6.1 participants listened to a sentence fragment and were presented with a picture in which they had to name to complete the sentence. The following sentences represent the English-English version of the stimuli materials:

Not paying attention, the driver hit	the red car
During the night, the thief stole	the orange bike
On the motorway, the driver missed	the green sign
After the shower, the swimmer grabbed	the blue towel
In the yard, the boy saw	the brown rabbit
In her room, the actress folded	the white dress
Feeling playful, the dog chewed	the grey pillow
For the dance, the woman wore	the red dress
After the race, the athlete won	the orange ribbon
In the store, the man bought	the green shirt
Fixing the house, the worker installed	the blue window
In the barn, the farmer fed	the brown pig
For the party, the man brought	the white TV
Feeling rushed, the worker broke	the grey knife
On his drawing, the architect used	the red ruler
In the night, the burglar stole	the orange bracelet
In the yard, the rabbit ate	the green leaf
In the shop, the carpenter used	the blue tape measure
Across the bay, the photographer saw	the brown castle
At the ceremony, the woman wore	the white glove
In the coup, the farmer kept	the grey chicken
Needing practice, the musician bought	the red piano
In the dark, the thief broke	the orange lock
On the street, the musician played	the green accordion
After the test, the student broke	the blue pencil
In the park, the boy chased	the brown dog
For Christmas, the family bought	the white tree
In art class, the child broke	the grey crayon
After painting, the artist cleaned	the red brush
In the forest, the camper picked	the orange mushroom
In the kitchen, the designer installed	the green fridge
Moving flats, the student brought	the blue kettle
At the park, the worker painted	the brown fence
For the dance, the girl wore	the white skirt
On his break, the man broke	the grey mug
At the zoo, the child saw	the red lion

Because of the mess, the girl grabbed
 In the yard, the child chased
 In the garden, the cat caught
 After work, the gardener put away
 In the yard, the man painted
 Because of the heat, the girl bought
 At dinner, the girl used
 During the storm, the boy watched
 At the store, the shopper filled
 In a hurry, the student forgot
 At work, the carpenter built
 In his office, the architect designed
 Losing his balance, the drunk held
 At the party, the girl broke
 Running late, the lawyer checked
 In the garden, the girl scared
 After the goal, the referee blew
 When it was late, the worker bolted
 After the battle, the troops raised
 For the winter, the gardener stored
 After breakfast, the maid folded
 In the garden, the rabbit ate
 On the street, the wind moved
 At breakfast, the boy used
 In the morning, the mother packed
 By the lake, the hunter shot
 Before the race, the runner filled
 In the storm, the city closed
 Forgetting his own, the traveler bought
 With his boat, the sailor visited
 In the dark, the girl took
 For the dance, the boy bought
 During lunch, the lawyer dirtied
 For lunch, the boy grabbed
 For the studio, the worker installed
 At the festival, the musician played

the orange broom
 the green butterfly
 the blue bird
 the brown hose
 the white fence
 the grey fan
 the red fork
 the orange lightning
 the green basket
 the blue folder
 the brown table
 the white tower
 the grey door knob
 the red cup
 the orange clock
 the green snake
 the blue whistle
 the brown door
 the white flag
 the grey rake
 the red sheets
 the orange flower
 the green bag
 the blue fork
 the brown bag
 the white goose
 the grey bottle
 the red bridge
 the orange toothbrush
 the green island
 the blue candle
 the brown trousers
 the white tie
 the grey bowl
 the red lightbulb
 the orange violin

The sentences below are from the German-German version and are translation
 equivalents of the English-English version.

Da er nicht aufpasste, rammte der Fahrer
 In der Nacht stahl der Dieb
 Auf der Autobahn verpasste der Fahrer

das rote Auto
 das orange Fahrrad
 das grüne Schild

Nach der Dusche schnappte sich der Schwimmer	das blaue Handtuch
Im Hof sah der Junge	das braune Kaninchen
In ihrem Zimmer faltete die Schauspielerin	das weiße Kleid
Da er verspielt war, zerkaute der Hund	das graue Kissen
Für den Tanz trug die Frau	das rote Kleid
Nach dem Rennen gewann der Athlet	das orange Band
In dem Laden kaufte der Mann	das grüne Hemd
Während der Reparatur des Hauses, installierte der Arbeiter	das blaue Fenster
In der Scheune fütterte der Bauer	das braune Schwein
Für die Party kaufte der Mann	den weißen Fernseher
Unter Zeitdruck brach der Arbeiter	das graue Messer
Für seine Zeichnung verwendete der Architekt	das rote Lineal
In der Nacht stahlen die Einbrecher	das orange Armband
Im Hof aß das Kaninchen	das grüne Blatt
In der Werkstatt verwendete der Schreiner	das blaue Metermaß
Jenseits der Bucht sah der Fotograf	das braune Schloss
Auf dem Fest trug die Frau	den weißen Handschuh
Im Hühnerschlag hielt der Bauer	das graue Hähnchen
Da er üben musste, kaufte der Musiker	das rote Klavier
In der Dunkelheit knackte der Dieb	das orange Schloss
Auf der Straße spielte der Musiker	die grüne Ziehharmonika
Nach dem Test zerbrach der Student	den blauen Bleistift
Im Park jagte der Junge	den braunen Hund
Für Weihnachten kaufte die Familie	den weißen Baum
Im Kunstunterricht zerbrach das Kind	den grauen Wachsmalstift
Nach dem Lackieren reinigte der Künstler	den roten Pinsel
Im Wald pflückte der Camper	den orangen Pilz
In der Küche installierte der Designer	den grünen Kühlschrank
Beim Umzug brachte der Student	den blauen Wasserkocher
Im Park strich der Arbeiter	den braunen Zaun
Für den Tanz trug das Mädchen	den weißen Rock
In seiner Mittagspause zerbrach der Mann	den grauen Becher
Im Zoo sah das Kind	den roten Löwen
Wegen der Unordnung nahm das Mädchen	den orangen Besen
Auf dem Hof jagte das Kind	den grünen Schmetterling
Im Garten fing die Katze	den blauen Vogel
Nach der Arbeit verstaute der Gärtner	den braunen Schlauch

Im Hof strich der Mann
Wegen der Hitze kaufte das Mädchen
Beim Abendessen verwendete das Mädchen
Während des Sturms sah der Junge
Im Laden füllte der Kunde
In Eile vergaß der Schüler
In der Arbeit baute der Zimmermann
In seinem Büro entwarf der Architekt
Schwankend hielt der Betrunkene
Auf der Party zerbrach das Mädchen
Da er spät dran war, sah der Anwalt auf
Im Garten erschreckte das Mädchen
Nach dem Tor blies der Schiedsrichter in
Wenn es spät wurde, verriegelte der Arbeiter
Nach der Schlacht schwenkten die Truppen
Über den Winter verstaute der Gärtner
Nach dem Frühstück faltete die Magd
Im Garten aß das Kaninchen
Auf der Straße bewegte der Wind
Beim Frühstück verwendete der Junge
Am Morgen packte die Mutter
Am See schoss der Jäger
Vor dem Rennen füllte der Läufer
Wegen des Sturms sperrte die Stadt
Da er seine eigene vergessen hatte, kaufte der Reisende
Mit seinem Boot besuchte der Seemann
In der Dunkelheit nahm das Mädchen
Für den Tanz kaufte der Junge
Während des Mittagessens beschmutzte der Anwalt
Beim Mittagessen nahm der Junge
Für das Studio installiert der Arbeiter
Auf dem Festival spielte der Musiker

den weißen Zaun
den grauen Fächer
den roten Löffel
den orangen Blitz
den grünen Korb
den blauen Ordner
den braunen Tisch
den weißen Turm
die graue Türklinke
die rote Tasse
die orange Uhr
die grüne Schlange
die blaue Pfeife
die braune Tür
die weiße Fahne
die graue Harke
die roten Bettlaken
die orange Blume
die grüne Tüte
die blaue Gabel
die braune Tüte
die weiße Gans
die graue Flasche
die rote Brücke
die orange Zahnbürste
die grüne Insel
die blaue Kerze
die braune Hose
die weiße Krawatte
die graue Schüssel
die rote Glühbirne
die orange Geige

The following pictures were paired with the sentence fragments:





D.2 Experimental material from Experiment 6.2

In Experiment 6.2 participants listened to a subordinate clause, and were shown pictures two characters, one representing the subject (subject characters) and one representing the indirect object of the sentence (dative characters). The infinitive form of a verb was visually presented at the same time as the pictures. The subject characters and family member characters are identical to those of Experiments 4.1 and 4.2. The following sentence fragments are the aurally presented subordinate clauses:

English subordinate clauses

Last Monday
Last Tuesday
Last Wednesday
Last Thursday
Last Friday
Last Saturday
Last Sunday
Last spring
Last summer
Last autumn
Last winter
Last night
Last week
Last month
Last year
In the morning
In the afternoon
In the evening
Before noon
Earlier today
Before breakfast
Before lunch
Before dinner
Before bed

German subordinate clauses

Am letzten Montag
Am letzten Dienstag
Am letzten Mittwoch
Am letzten Donnerstag
Am letzten Freitag
Am letzten Samstag
Am letzten Sonntag
Im letzten Frühjahr
Im letzten Sommer
Im letzten Herbst
Im letzten Winter
Letzte Nacht
Letzte Woche hat
Letzten Monat hat
Im letzten Jahr
Am Morgen
Am Nachmittag
Am Abend
In der Nacht
Bereits heute Morgen
Vor dem Frühstück
Vor dem Mittagessen
Vor dem Abendessen
Vor dem Schlafengehen

The following are the dative verbs presented:

English verbs

resemble
answer

German verbs

ähneln
antworten

meet	begegnen
thank	danken
serve	dienen
threaten	drohen
allow	erlauben
follow	folgen
obey	gehorschen
believe	glauben
congratulate	gratulieren
help	helfen
overhear	lauschen
fail	misslingen
advise	raten
harm	schaden
flatter	schmeicheln
trust	trauen
forgive	verzeihen
contradict	widersprechen

The subject characters in Experiment 6.2 are identical to the family member characters in Experiments 4.1, 4.2, 5.1 and 5.2. The dative characters in Experiment 6.2 are identical to the subject characters in Experiments 4.1, 4.2, 5.1, and 5.2.